UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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GOOGLE LLC

Petitioner

v.

ECOFACTOR, INC.

(record) Patent Owner

IPR2020-00947
Patent No. 8,131,497

PETITION FOR INTER PARTES REVIEW
UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. § 42.100 ET. SEQ

TABLE OF CONTENTS

TABLE OF EXHIBITS

Exhibit No.	Description
1001	U.S. Patent No. 8,131,497 ("**the '497 patent**").
1002	Declaration of Rajendra Shah.
1003	C.V. of Rajendra Shah.
1004	U.S. Pat. App. Pub. 2005/0171645 ("**Oswald**").
1005	U.S. Pat. No. 4,897,798 ("**Cler**").
1006	*Exhibit number not used.*
1007	Joint Claim Construction Chart in *Smart HVAC Systems, and Components Thereof,* 337-TA-1185 (ITC March 6, 2020).
1008	U.S. Pat. No. 6,216,956 ("**Ehlers**").
1009	U.S. Pat. No. 5,943,544 ("**Charles**").
1010	U.S. Pat. No. 6,789,739 ("**Rosen**").
1011	File History of U.S. App. Ser. No. 12/959,225.
1012	*Exhibit number not used.*
1013	File History of U.S. App. Ser. No. 12/211,733.
1014	U.S. Pat. App. Pub. 2005/0288822 ("**Rayburn**").
1015	U.S. Pat. No. 4,660,759 ("**Barnard**").
1016	U.S. Pat. No. 6,029,092 ("**Stein**").
1017	Horan, T, *Control Systems and Applications for HVAC/R*, Prentice-Hall, Inc., 1997.
1018	Levenhagen, J, *HVAC Control and Systems*, McGraw-Hill, Inc., 1993.

Petitioner respectfully requests *inter partes* review under 35 U.S.C. § 311 of claims 1-12 of U.S. Pat. No. 8,131,497 ("the '497 patent").

NOTICE OF LEAD AND BACKUP COUNSEL

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NOTICE OF THE REAL-PARTIES-IN-INTEREST

The real-party-in-interest for this petition is Google LLC ("Google").

NOTICE OF RELATED MATTERS

Another petition challenging the same claims of the '497 patent has been filed concurrently and assigned trial number IPR2020-00946.

The '497 patent has also been asserted in the following litigations:

- *EcoFactor, Inc. v. Google LLC*, 1-19-cv-12322 (D. Mass. Nov. 12, 2019);
- *EcoFactor, Inc. v. Alarm.com Inc. et al.*, 1-19-cv-12323 (D. Mass. Nov. 12, 2019);
- *EcoFactor, Inc. v. Daikin Industries, Ltd. et al.*, 1-19-cv-12324 (D. Mass. Nov. 12, 2019);
- *EcoFactor, Inc. v. Ecobee, Inc. et al.*, 1-19-cv-12325 (D. Mass. Nov. 12, 2019);

- *EcoFactor, Inc. v. Schneider Electric USA, Inc. et al*., 1-19-cv-12326 (D. Mass. Nov. 12, 2019);
- *EcoFactor, Inc. v. Vivint, Inc.*, 1-19-cv-12327 (D. Mass. Nov. 12, 2019); and
- *Smart HVAC Systems, and Components Thereof*, 337-TA-1185 (ITC).

The district court litigations have been stayed pending the ITC investigation.

NOTICE OF SERVICE INFORMATION

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GROUNDS FOR STANDING

Petitioner hereby certifies that the patent for which review is sought is available for *inter partes* review, and that the Petitioner is not barred or estopped from requesting an *inter partes* review on the grounds identified in the petition.

STATEMENT OF PRECISE RELIEF REQUESTED

Petitioner respectfully requests that claims 1-12 of the '497 patent be canceled based on the following grounds:

Ground 1: Claims 1, 4, 7, and 10 are anticipated by Oswald.

Ground 2: Claims 1, 3-7, and 9-12 are obvious over Oswald in view of Cler and the knowledge of the person of ordinary skill.

Ground 3: Claims 2 and 8 are obvious as in Ground 2, in further view of

Rosen.

THRESHOLD REQUIREMENT FOR INTER PARTES REVIEW

This petition presents "a reasonable likelihood that the Petitioners would prevail with respect to at least one of the claims challenged in the petition", 35 U.S.C. § 314(a), as shown in the Grounds explained below.

I. INTRODUCTION

A. The '497 Patent Disclosure

The '497 patent at-issue (with an earliest-possible benefit date of 2007) relates generally to heating or cooling systems ("HVAC systems"). (Ex. 1001, Abstract, 1:17-18)(Ex. 1002, ¶30). Such HVAC systems have, for decades, been controlled by thermostats. (Ex. 1001, 1:24-42)(Ex. 1002, ¶30). Thermostats are typically wall-mounted units that have an internal temperature sensor, and which allow a user to set a target temperature. (Ex. 1001, 1:31-42)(Ex. 1002, ¶¶30-31). The target temperature, or "setpoint", is compared against the actual temperature, and the HVAC system switched on or off in an attempt to maintain the setpoint temperature. (Ex. 1001, 1:31-42)(Ex. 1002, ¶¶32-34).

The '497 patent states that there may be opportunities to improve typical thermostat function. (Ex. 1001, 1:53-62)(Ex. 1002, ¶35). For example, the '497 patent discusses having a server that uses measurements of inside temperature, outside temperature, and other factors to predict the building's thermal characteristics and the performance of the HVAC system. (Ex. 1001, 8:63-9:9)(Ex.

1002, ¶¶36-37). As the ’497 patent notes, the rate at which an HVAC system can heat or cool a building depends on the temperature outside and the thermal properties of the building. (Ex. 1001, 2:52-67)(Ex. 1002, ¶¶36-37). Temperature and thermal properties, states the ’497 patent, can in turn be used in calculations relating to HVAC systems. (Ex. 1001, 11:10-19)(Ex. 1002, ¶37).

The exact nature of the calculations in the ’497 patent, however, is not disclosed. (Ex. 1002, ¶38). Rather, the ’497 patent states only generally that inside temperature, outside temperature, and other factors are taken into account, and that the server can calculate the “thermal mass index” of a house “by applying a basic algorithm that weighs each of these external variables as well as variables for various characteristics of the home itself (such as size, level of insulation, method of construction, etc.) and data from other houses and environments.” (Ex. 1001, 11:8-19)(Ex. 1002, ¶38).

Independent claim 1 of the ’497 patent reads as follows:

> “1. A system for calculating a value for the operational efficiency of a heating, ventilation, and air conditioning (HVAC) system comprising:
>
> at least one HVAC control system that receives temperature measurements from at least a first location conditioned by at least one HVAC system;
>
> one or more databases that store at least said temperatures measured at said first location over time; and

one or more processors that receive outside temperature measurements from at least one source other than said HVAC system,

wherein said one or more processors are configured to calculate one or more rates of change in temperature at said first location for periods during which the status of the HVAC system is 'on' and

wherein said one or more processors are further configured to calculate one or more rates of change in temperature at said first location for periods during which the status of the HVAC system is 'off', and

to relate said calculated rates of change to said outside temperature measurements."

Thus, claim 1 is directed overall to a system for calculating operational efficiency. The system must also be able to calculate the rates of change of temperature at a first location (essentially, the "**inside** temperature") when an HVAC system is 'on' and when it is 'off', and then relate these rates of change to the **outside** temperature. (Ex. 1002, ¶¶39-40).

The '497 patent does not describe any particular calculations for operational efficiency. Nor does the '497 patent describe calculations for the rates of change when the HVAC system is 'on' or 'off', or how those might relate to operational efficiency, if at all. (Ex. 1002, ¶41).

While the calculations underpinning the '497 patent are murky, the principal limitations of the '497 patent claims were well-known in the art. Specifically, it was

well-known that the rate at which a building loses or gains heat is proportional to the difference between the indoor and outdoor temperature. (Ex. 1002, ¶42). For example, on a hot summer afternoon, a building will gain heat (incur a rise in temperature) faster than on a cool day. (Ex. 1002, ¶42). This places a greater demand on the air conditioning system on a hot day. (Ex. 1002, ¶42). Similarly, on a cold winter day, the building will lose heat more quickly, placing greater demand on the heating system. (Ex. 1002, ¶42). By extension, the apparent ability of the HVAC system to change the temperature of the house (and thus the rate of change of temperature) depends strongly on the external temperature. (Ex. 1002, ¶42).

The relationship between the rate of change of inside temperature and the outside temperature was both common sense and textbook knowledge in the relevant timeframe. (Ex. 1002, ¶43)(*citing* Ex. 1017, p. 200; Ex. 1018, p. 281). More specifically, it was well-understood that the rate of heat transfer into or out of a building (without the application of an HVAC system) was directly proportional to the difference between exterior and interior temperature. (Ex. 1002, ¶43). Thus, the larger the difference between the inside and outside temperature, the faster a building would heat up or cool down. (Ex. 1002, ¶43).

One common prior art application that used the concepts of claim 1 of the '497 patent (rates of change with the HVAC system 'on' and 'off' and the outside temperature) related to a so-called "setback" schedule. (Ex. 1002, ¶44). A setback

schedule is simply a schedule to change the setpoint of a thermostat at different times of day, in order to save energy. (Ex. 1002, ¶45). For example, a user might program a workplace thermostat during the winter to have a daytime (8 AM to 5 PM) setpoint of 70 F, but an evening setpoint of 50 F (when the building is expected to be unoccupied). (Ex. 1002, ¶45). To achieve these set points, the thermostat would turn the HVAC system 'off' at 5 PM, but turn it back on sometime before 8 AM, to make sure the workplace was warm enough by 8 AM. (Ex. 1002, ¶46). Setting the setpoint down to 50 F (*e.g.*) was called "setback", while heating the building back up to 70 F in the morning was called "recovery". (Ex. 1002, ¶46).

A further refinement of the setback and recovery concept was known as "optimum start / stop". The point of optimum start / stop was to calculate the *optimum* time to stop the HVAC system prior to setback, as well as the *optimum* time to start the HVAC system again to begin recovery. (Ex. 1002, ¶47). It was understood decades before the '497 patent that HVAC systems could be turned off somewhat prior to their scheduled setback time, and allowed the building to drift to the setback temperature (in the present example, drifting from 70 F to 50 F), without causing the building to become uncomfortable. (Ex. 1002, ¶48). This could save energy by turning off the HVAC system somewhat early. (Ex. 1002, ¶48). Similarly, to perform recovery from a setback temperature, the HVAC system would be turned on at the latest possible time to reach the daytime temperature in time for occupancy.

(Ex. 1002, ¶48).

To determine the optimum stopping and starting times, one needed to know *how fast* the HVAC system could heat or cool a structure, and *how fast* the structure would naturally heat or cool when the HVAC system was 'off'. (Ex. 1015, 1:60-2:13)(Ex. 1002, ¶49). Knowing how fast the temperature changed (*i.e.* the rate of change in temperature) would allow one to calculate the best times to turn the HVAC system 'on' and 'off'. ((Ex. 1015, 1:60-2:13)(Ex. 1002, ¶49). Both of rates were, of course, affected by the outside temperature. (Ex. 1002, ¶50). As noted above, it is harder to heat a building on a cool day, and harder to cool a building on a warm day. (Ex. 1002, ¶50). The textbook "Control Systems and Applications for HVAC/R" explains:

> "*Optimum Start* and *Optimum Stop* are strategies that further reduce electrical *consumption* in comparison to time of day scheduling. They *vary* the scheduled start and stop times of the equipment based upon current environmental conditions. The time of day program confines equipment to a fixed operating schedule. **On extreme weather days, the zone may take 60 minutes to reach comfort levels while during milder weather day it may only take 20 minutes.** The time of day program schedule must reflect the earliest start time to be sure the zone is at comfort set point before the occupants arrive. Any additional time the equipment operates at the occupied period set point, before the occupied period begins, wastes energy."

(Ex. 1017, p. 261)(Emphasis added)(Ex. 1002, ¶50).

Optimum start / stop calculations were common in the prior art. For example, Levenhagen's 1993 textbook entitled "HVAC Controls and Systems", published 14 years prior to the first application leading to the '497 patent, states:

> "*Optimum start and stop* is one of the most commonly used standard EMS programs. Here, the outdoor air temperature and inside space temperatures are used to calculate the lead time necessary to condition a space to achieve comfort conditions by the time of occupancy."

(Ex. 1018, p. 281)(Ex. 1002, ¶51).

Given applications like optimum start / stop, the principal claimed elements of the '497 patent (rates of change with the HVAC system 'on' and 'off', as related to outside temperature) were already in widespread use in numerous prior art systems. These systems, like the '497 patent, sought to more efficiently manage HVAC systems to reduce energy consumption. (Ex. 1002, ¶52). One such system is described by U.S. Pat. Pub. 2005/0171645 to Oswald (Ex. 1004), which is the principal prior art reference relied upon by the present Petition.

II. CLAIM CONSTRUCTION

"In an inter partes review proceeding, a claim of a patent…shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b)…." 37 C.F.R. §42.100(b).

A. Claim Constructions in Co-pending Litigations

Various parties to the ITC investigation captioned *Smart HVAC Systems, and Components Thereof* 337-TA-1185 (ITC) have taken claim construction positions, shown in Ex. 1007.

B. Claims 1-2, 4-5, 7-9, and 11—"HVAC system" or "heating, ventilation, and air conditioning (HVAC) system"

Claim 1 uses the phrase "heating, ventilation, and air conditioning (HVAC) system", while claims 1-2, 4-5, 7-9, and 11 use the phrase "HVAC system".

The '497 patent uses the term "HVAC system" to mean devices for heating and/or cooling generally. For example, the '497 patent states:

> "HVAC units may be conventional air conditioners, heat pumps, **or** other devices for transferring heat into or out of a building."

(Ex. 1001, 7:19-21)(Emphasis added)(Ex. 1002, ¶58).

The Board should thus construe the phrases "heating, ventilation, and air conditioning (HVAC) system" and "HVAC system" to mean "*devices for transferring heat into or out of a building*". (Ex. 1002, ¶59).

III. DETAILED EXPLANATION OF THE REASONS FOR UNPATENTABILITY

Ground 1. Claims 1, 4, 7, and 10 are anticipated by Oswald

Claims 1, 4, 7, and 10 are anticipated under pre-AIA 35 U.S.C. §§ 102(b) by

U.S. Pat. App. Pub. 2005/0171645 ("**Oswald**")(Ex. 1004).

Oswald was not of record during any application leading to the '497 Patent.

A. Effective Prior Art Dates

Oswald was published on August 4, 2005, and is therefore prior art under pre-AIA 35 U.S.C. § 102(b).

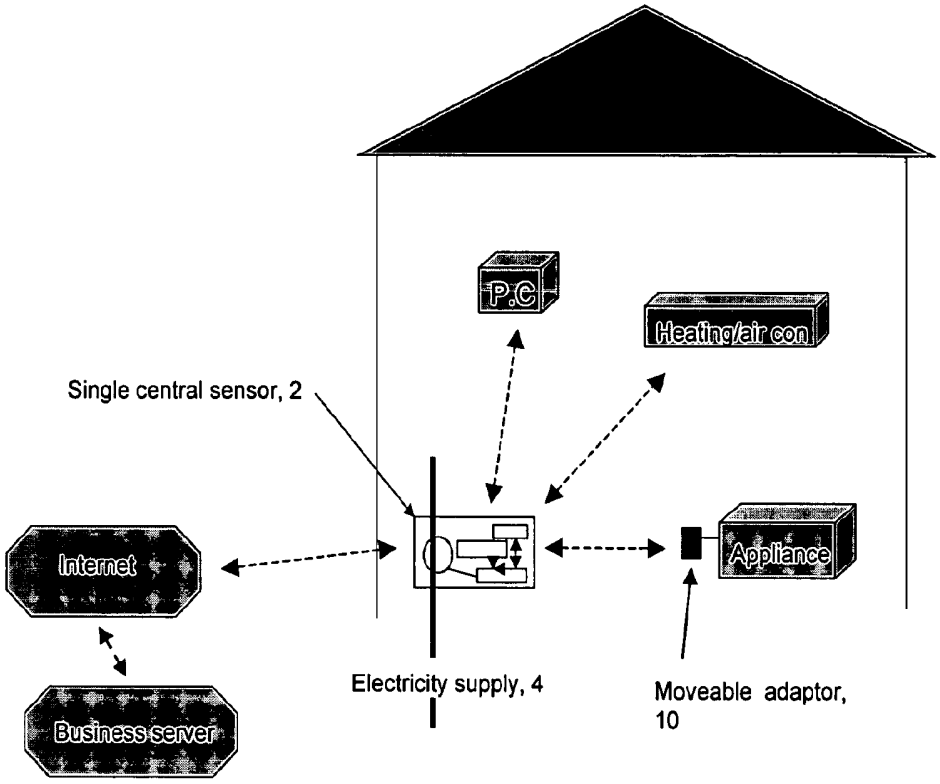
B. Overview of the Ground

Oswald anticipates the challenged claims. (Ex. 1002, ¶63). Oswald teaches a household energy management system that:

> "uses measurements of the household electricity supply 4 to identify and to determine the energy consumption of individual household appliances. From these measurements, **models can be built of** the behaviour of the occupants of the house, the **thermal properties** of the house and the **efficiency of the appliances**."

(Ex. 1004, Abstract)(Emphasis added)(Ex. 1002, ¶64).

An overview of Oswald's system is shown in Fig. 3, reproduced here:



(Ex. 1002, ¶65). As shown in Fig. 3, Oswald's system has a processor ("P.C.") and an HVAC System ("Heating/air con"). These components communicate with a "Single central sensor, 2". (Ex. 1002, ¶¶66-67).

To model thermal properties and efficiency, Oswald teaches creating a "transient thermal model". (Ex. 1004, ¶¶0024-0025, claims 27-28)(Ex. 1002, ¶68). The transient thermal model receives inside and outside temperature measurements. (*Id.*). Using these measurements, the transient thermal model calculates both the efficiency of the HVAC system and the rates of heating and cooling when the HVAC system is 'on' and 'off'. (Ex. 1004, ¶¶0036, 0141, 0146-0148)(Ex. 1002, ¶68). Oswald states:

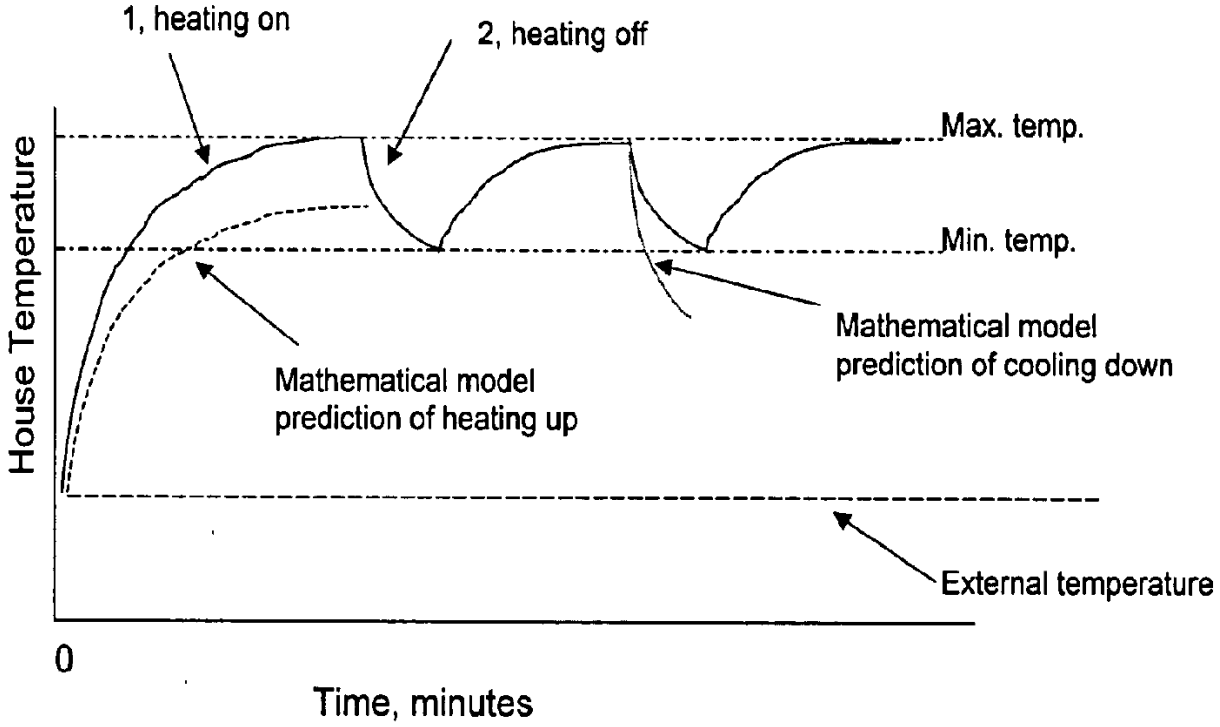
> "The household energy management system according to the second aspect of the invention may further comprise one or more temperature sensors for measuring **the temperature inside the house**; a source of information about **the temperature outside the house**; a modelling means, which **uses the inside and outside temperature measurements to derive a transient thermal model of the house, which can predict changes in the inside temperature on the basis of the information about the outside temperature** and on the basis of the operation of heating and/or cooling electrical appliances identified as connected to the supply…."

(Ex. 1004, ¶0024)(Emphasis added)(Ex. 1002, ¶69). Oswald continues:

> "In such a system, **the derived transient thermal model may be periodically updated** and the reference transient thermal model may be a derived transient thermal model from an earlier period, whereby the **warning means are for warning the user** of the system of deteriorating thermal properties of the house or **of deteriorating efficiency of the connected heating and/or cooling electrical appliances.**"

(Ex. 1004, ¶0025)(Emphasis added)(Ex. 1002, ¶69).

Once created, the transient thermal model is used to make predictions about how the HVAC system will heat and cool the house, as shown, *e.g.*, in Oswald's Fig. 8, reproduced here:



(Ex. 1004, Fig. 8, ¶¶0135-0136)(Ex. 1002, ¶¶70-71). As shown in Fig. 8, Oswald calculates expected house temperature as a function of time, including the rates at which the house heats and cools with the HVAC system 'on' and 'off' (*see* Fig. 8 above, labels near the top "1. heating on" and "2. heating off"). These values were calculated using the measurements of inside temperature over time as well as outside temperature over time, and are thus "related" to outside temperature measurements. (Ex. 1002, ¶¶70-71).

C. Claim Mapping

This section maps the challenged claims to the relevant disclosures of Oswald, where the claim text appears in bold-italics, and the relevant mapping follows the claim text. The Petitioner has added numbering and lettering in brackets (*e.g.* [1a],

[1b]) to certain claim elements, to facilitate the discussion.

Independent Claim 1

"1[a]. A system for calculating a value for the operational efficiency of a heating, ventilation, and air conditioning (HVAC) system comprising:"

Oswald teaches a system **for calculating a value for the operational efficiency of a heating, ventilation, and air conditioning (HVAC) system**. As discussed in the Overview section, Oswald relates to an Energy Management System ("EMS"). (Ex. 1004, Title, Abstract, ¶¶0002, 0012)(Ex. 1002, ¶¶74-75). Oswald states:

> "[a] household energy management system uses measurements of the household electricity supply 4 to identify and to determine the energy consumption of individual household appliances. From these measurements, **models can be built of** the behaviour of the occupants of the house, the thermal properties of the house and **the efficiency of the appliances**."

(Ex. 1004, Abstract)(Emphasis added)(Ex. 1002, ¶75). Oswald makes clear that "efficiency" is the same as "operational efficiency". (Ex. 1004, ¶0036)(Ex. 1002, ¶75).

Among its "appliances", Oswald's EMS includes **HVAC** systems. Oswald's Abstract continues:

> "Using the models, the **household appliances**—in particular,

> **heating and cooling appliances—can be controlled** to optimize energy efficiency…."

(Ex. 1004, Abstract, ¶¶0122-0148, claims 8, 27-28)(Ex. 1002, ¶76). As discussed above in §II.B, Oswald's "heating and cooling appliances" are HVAC systems because they are "devices for transferring heat into or out of a building". (Ex. 1002, ¶83).

Oswald further teaches that its EMS **calculates a value for the operational efficiency of an HVAC system**. (Ex. 1004, ¶¶0033-0036, 0122-0148, claims 27-28)(Ex. 1002, ¶77). As discussed in the Overview section, Oswald teaches that its EMS can construct and continuously update a "transient thermal model" of a house. (Ex. 1004, ¶¶0122-0126)(Ex. 1002, ¶77). The transient thermal model is used to evaluate the operational efficiency of the HVAC system over time. (Ex. 1004, Abstract, claims 27-28, ¶¶0036, 0146-0148, 0024-0025)(Ex. 1002, ¶77). For example, Oswald states that "models can be built of the behaviour of the occupants of the house, the thermal properties of the house and the **efficiency** of the appliances." (Ex. 1004, Abstract)(Emphasis added)(Ex. 1002, ¶78).

Oswald further states that its system provides the benefit of "[r]ecommending energy saving measures to the householder **based on actual measurements of** the householder's behaviour, the thermal efficiency of the house and the **operational efficiency of household appliances**." (Ex. 1004, ¶¶0033-0036)(Emphasis

added)(Ex. 1002, ¶78). In particular, Oswald repeatedly updates the thermal model and estimates of operational efficiency, and warns a user when the operational efficiency deteriorates. (Ex. 1004, ¶¶0025, 0146, 0036)(Ex. 1002, ¶79).[1]

"[1b] at least one HVAC control system that receives temperature measurements from at least a first location conditioned by at least one HVAC system;"

Oswald teaches **at least one HVAC control system that receives temperature measurements from at least a first location conditioned by at least one HVAC system**. (Ex. 1002, ¶81). First, Oswald teaches that its Energy Management System ("EMS") has components in **a first location conditioned by at least one HVAC system**, such as a house, that are used to manage appliances at that location. (Ex. 1004, Abstract, claim 1, ¶¶0012-0018, 0123-0127, 0135-0148)(Ex. 1002, ¶82).

An **HVAC control system** in Oswald is the "single central sensor 2". (Ex. 1004, ¶¶0054-0057, 0148, 0119, 0086-0089, Fig. 8)(Ex. 1002, ¶88). The sensor 2 helps control the HVAC system. (Ex. 1004, ¶¶0101, 0139, 0148)(Ex. 1002, ¶83).

[1] The claim construction dispute in co-pending ITC investigation 337-TA-1185 is not believed to be relevant here, because Oswald directly and expressly teaches calculating operational efficiency. (Ex. 1007, p. 4).

For example, Oswald states:

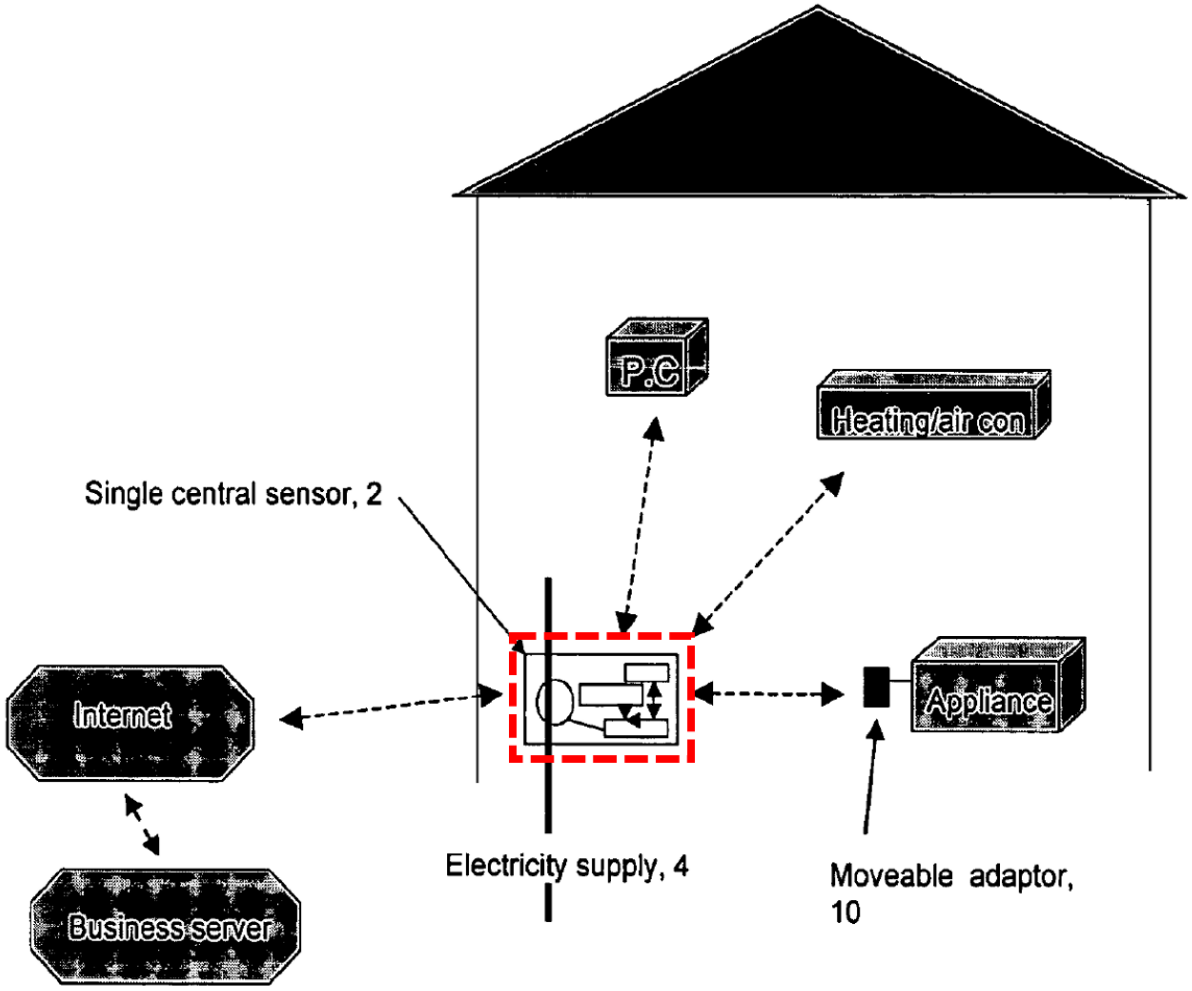
> "**The single central sensor system can alter the control temperature of the house** if the householder is obviously active or has gone out."

(Ex. 1004, ¶0101)(Ex. 1002, ¶83). Oswald further states that the sensor 2 performs an optimum start / stop function:

> "With the use of the transient thermal model, the householder can now define when the house is to reach the controlled temperature schedule rather than when to start heating. This allows the single central sensor system to calculate the optimum time to turn on."

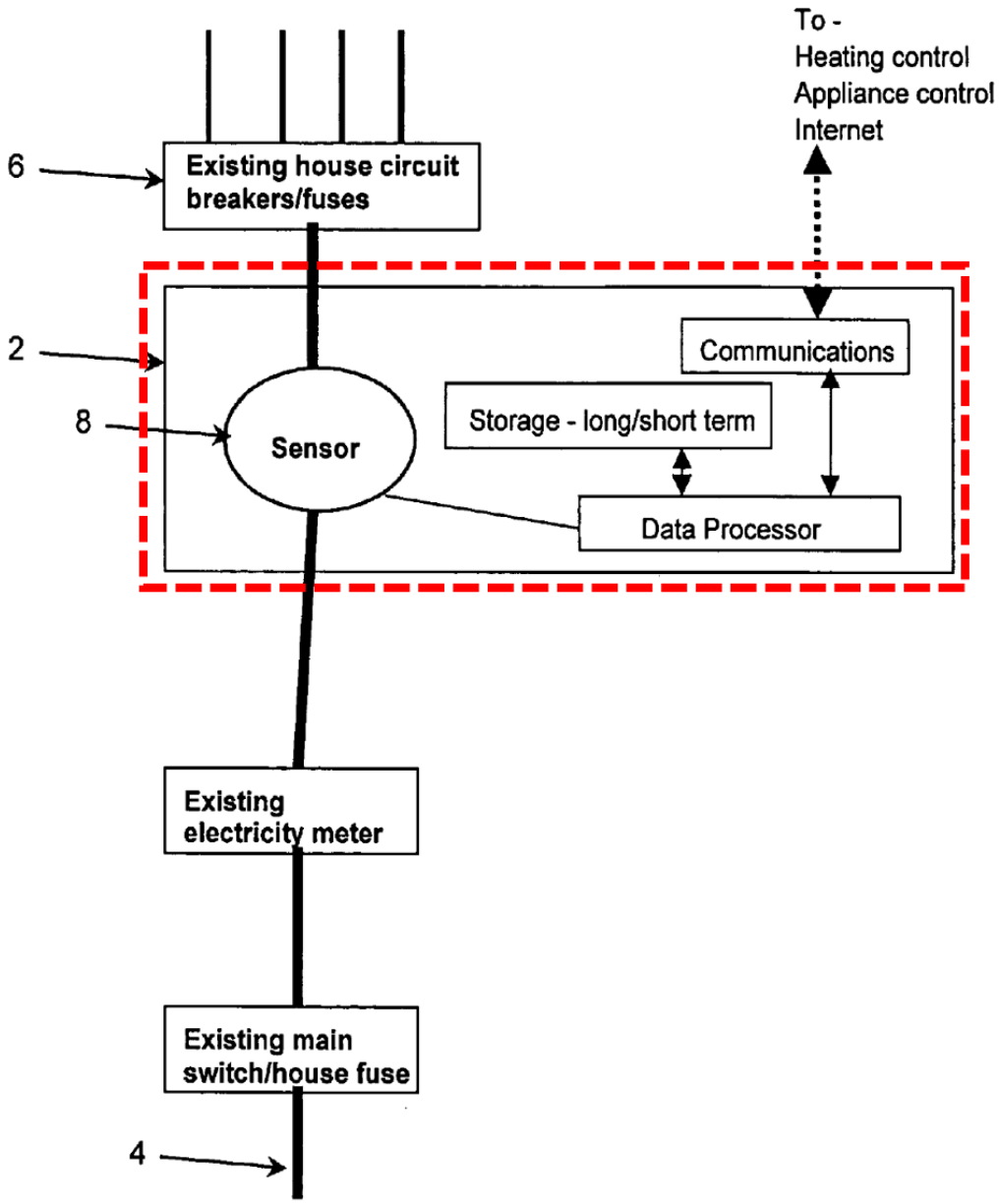
(Ex. 1004, ¶0139)(Ex. 1002, ¶83).

The sensor 2 is shown in part in Oswald's Fig. 3, which is reproduced below with added red-dashed outline around the HVAC control system:



(Ex. 1002, ¶84).

The box labeled "single central sensor, 2" in Fig. 3, above, is shown in more detail in Oswald's Fig. 1, which is reproduced below, again with portions that belong to the HVAC control system outlined with an added, red-dashed outline:



(Ex. 1002, ¶86).

Oswald's HVAC control system **receives temperature measurements from a structure** (the house). (Ex. 1002, ¶87). Specifically, Oswald teaches that its EMS includes one or more temperature sensors inside the house. Oswald states:

> "**The household energy management system according to the second aspect of the invention may further comprise one or more**

> **temperature sensors for measuring the temperature inside the house**; a source of information about the temperature outside the house; **a modelling means, which uses the inside and outside temperature measurements to derive a transient thermal model** of the house…."

(Ex. 1004, ¶0024)(*see also* Ex. 1004, claim 27)(Emphasis added)(Ex. 1002, ¶87).

At least one of these sensors is located in a thermostat. (Ex. 1004, ¶0148)(Ex. 1002, ¶88). Oswald teaches a thermostat that has a temperature sensor, and this sensor passes temperature measurements to the sensor 2 (HVAC control system) (Ex. 1004,¶0148)(Ex. 1002, ¶88). For example, Oswald states:

> "[A] special house thermostat that communicates with the single central sensor 2 can be used. This thermostat acts as a normal house thermostat—switching open and closed as the temperature rises and falls through set limits. However, **it communicates this to the single central sensor 2 so that the system can still determine when temperature limits are reached** and **the transient thermal model can still be aligned with the real thermal response**."

(Ex. 1004, ¶0148)(Emphasis added)(Ex. 1002, ¶88). From the paragraph above, a person having ordinary skill in the art ("POSA") would have understood that the sensor 2 receives information that the thermostat has "switch[ed] open [or] closed as the temperature [rose] and [fell] through set limits", (Ex. 1002, ¶88), and that Oswald uses such information to "determine when temperature limits are reached"

and align the transient thermal model with "real thermal response". (Ex. 1002, ¶88). Aligning the transient thermal model with the real thermal response means adjusting the model so that its output (expected inside temperature as a function of time as shown in Fig. 8) closely matches the actual inside temperature as a function of time. (Ex. 1002, ¶¶71, 88)(Ex. 1004, Fig. 8, ¶¶0135-0136). Oswald's sensor 2 could not "determine when temperature limits are reached", nor update the transient thermal model to be "aligned with the real thermal response" (*i.e.* the inside temperature) without access to the inside temperature as measured by the thermostat. (Ex. 1002, ¶88).

Thus, Oswald teaches **at least one HVAC control system that receives temperature measurements from at least a first location conditioned by at least one HVAC system**. (Ex. 1002, ¶96).

"[1c] one or more databases that store at least said temperatures measured at said first location over time; and"

Oswald teaches **one or more databases that store at least said temperatures measured at said first location over time**. Here, the claim phrase "said temperatures measured at said first location" refers to Oswald's inside temperature measurements, as discussed above under claim limitation [1b]. (Ex. 1002, ¶90).

Oswald teaches that all "acquired data" will be stored in a database:

> "Stored data [0059] **The data acquired will be stored on a database**. This will include data of appliance characteristics, times appliances are on and off and derived data. It can be stored either within the house in some form of small computer, perhaps as part of the single central sensor 2, or on a more powerful server on the Internet-based network of computers."

(Ex. 1004, ¶¶0058-0059)(Emphasis added)(Ex. 1002, ¶91). Because inside temperature measurements are acquired from sensors, they are "acquired data", and a POSA would have understood them to be stored in Oswald's database. (Ex. 1002, ¶92).

While this literally applies to all temperature data (*i.e.* data acquired **over time**), Oswald also teaches that inside temperature data acquired "over time" is stored in the database, because **(1)** the temperature over time is needed to align the transient thermal model with temperature over time (Ex. 1004, ¶¶0148, 0135-0136, Fig. 8)(Ex. 1002, ¶¶71, 77, 93) and **(2)** the EMS compares different versions of the transient thermal model from different times to evaluate HVAC efficiency. (Ex. 1004, ¶¶0024-0025, claims 27-28)(Ex. 1002, ¶93). For example, Oswald teaches that the EMS has:

> "**means for comparing the derived transient thermal model with a reference transient thermal model**….In such a system, the derived transient thermal model may be periodically updated and **the reference transient thermal model may be a derived transient**

thermal model from an earlier period…."

(Ex. 1004, ¶¶0024-0025)(Emphasis added)(Ex. 1002, ¶93). Oswald further states that "the best fit with all known data" will be achieved. (Ex. 1004, ¶0136)(Ex. 1002, ¶93).

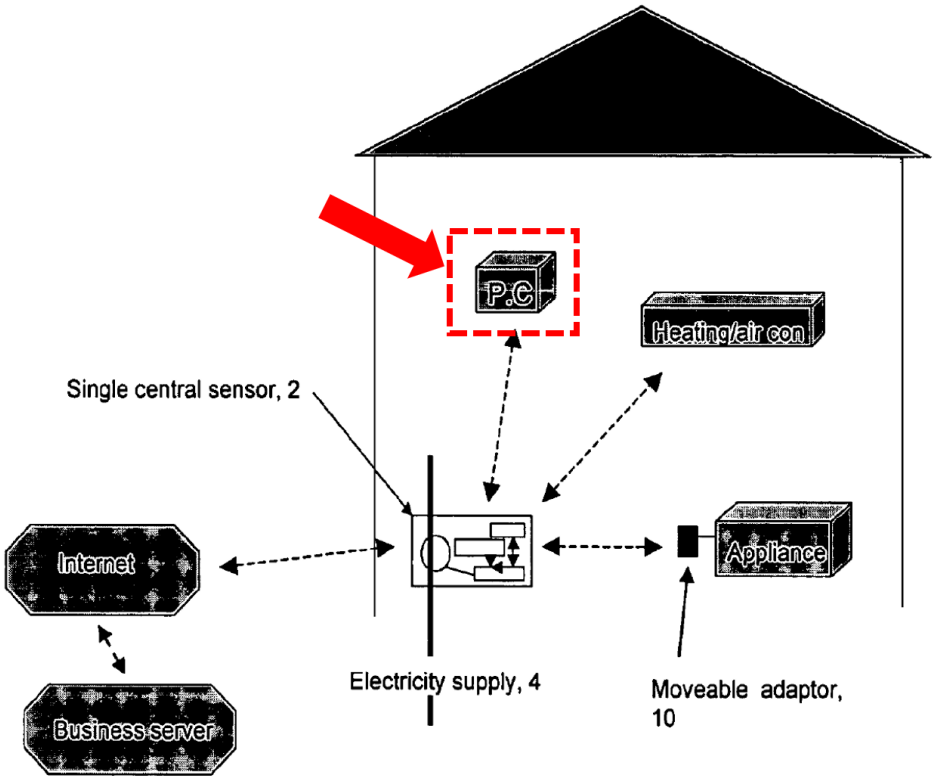
"[1d] one or more processors that receive outside temperature measurements from at least one source other than said HVAC system,"

Oswald teaches a **processor**. (Ex. 1004, ¶¶0052, 0057)(Ex. 1002, ¶¶95-96). The processor performs the analyses done for the EMS:

> "The analysis is performed on computers either local to the house or on the Internet. Communications between the various system items use standard known communication systems i.e. phone, radio, Internet or communication by power cable."

(Ex. 1004, ¶0052)(*see also* Ex. 1004, ¶¶0046-0057)(Ex. 1002, ¶96).

One example of a processor is shown in the annotated version of Fig. 3 of Oswald, reproduced below with an added red-dashed box around and an arrow indicating the PC (Personal Computer) within a house:



(Ex. 1002, ¶96). The processor can be within the sensor 2 or outside of it, as shown by the P.C. in Fig. 3. (Ex. 1002, ¶97).

Oswald further teaches that the **processor receives outside temperature measurements from at least one source other than said HVAC system,** and uses them to construct a transient thermal model of the house. (Ex. 1004, ¶¶0024-0025, 0123-0133)(Ex. 1002, ¶¶98-99). Oswald states:

> "A transient thermal model of the house can be generated and validated by the system…. [0128] **Terms in the thermal model would include:** [0129] Heat transfer coefficient inside house. [0130] Heat transfer coefficient outside house—terms including effect of wind, rain, humidity etc. [0131] Temperature inside.

[0132] **Temperature outside**. ”

(Ex. 1004, ¶¶0123-0132)(Emphasis added)(Ex. 1002, ¶99). Thus, the **processor receives** the outside temperature measurements because it needs them to calculate the model. (Ex. 1004, ¶0052)(*see also* Ex. 1004, ¶¶0046-0057)(Ex. 1002, ¶99).

The outside temperature measurements are received **from at least one source other than said HVAC system.** Note that this claim term refers to the “HVAC system” (*i.e.* the furnace and/or air conditioners themselves), not the “HVAC control system” (*i.e.* sensor 2). Oswald states:

> “The household energy management system according to the second aspect of the invention may further comprise one or more temperature sensors for measuring the temperature inside the house; **a source of information about the temperature outside the house**; a modelling means, which uses the inside and outside temperature measurements to derive a transient thermal model of the house….”

(Ex. 1004, ¶0024, claim 27)(Emphasis added)(Ex. 1002, ¶100). In this passage, the *inside* temperature comes from a temperature sensor inside the house, whereas the *outside* temperature comes from “a source of information about the temperature outside the house.” This teaches that the information about outside temperature does not come from a sensor that is part of the HVAC system, but rather an outside source. (Ex. 1002, ¶101).

Oswald further teaches that:

> "The system can use network data to improve validity. For example it can be informed of **local weather** from existing Internet weather databases which have weather information from nearby weather stations."

(Ex. 1004, ¶0137)(Ex. 1002, ¶102). A POSA would have considered outside temperature to be a part of local weather data, and would have understood "validity" in the above quote to mean the need to incorporate outside temperature into a transient thermal model (because without taking outside temperature into account, the model is invalid). (Ex. 1002, ¶102).

Oswald's teachings (1) to use outside temperature, (2) that outside temperature (in contrast to inside temperature) can be taken from "a source of information about the temperature outside the house", and (3) that the system can access either a sensor or local weather information, disclosed receiving a measurement of outside temperature from a source other than the HVAC system, either from a temperature sensor outside the house, or from local weather reports over the Internet. (Ex. 1002, ¶1¶03-104).

> ***"[1e] wherein said one or more processors are configured to calculate one or more rates of change in temperature at said first location for periods during which the status of the HVAC system is 'on' and wherein said one or more processors are further configured to calculate one or more rates of change in temperature at said first location for periods during which the status of the HVAC system is 'off', and"***

Oswald teaches that the **processor is configured to calculate one or more rates of change in temperature at said first location** for times when the **HVAC system is 'on'** and times when it is '**off**'. (Ex. 1004, ¶¶0103, 0123-0124, 0139, 0141, 0143, 0146-0147)(Ex. 1002, ¶106). Oswald states, for example, that:

> "**The validated thermal transient model can be used** to compare the house to national house norms. In this way the thermal characteristics of the house can be compared to acceptance limits and weaknesses in the house thermal characteristics can be identified and remedied. **For example the system may notice that the house cools down unusually quickly** on windy days and yet has a normal cooling characteristic under still air conditions. This will indicate that the house is susceptible to wind and is therefore draughty."

(Ex. 1004, ¶0143)(Emphasis added)(Ex. 1002, ¶107). Oswald likewise states:

> "**The transient thermal model can be used** to determine the operational health of the heating system within the house. As explained previously, the system will continuously adjust coefficients within the transient thermal model to ensure it aligns with the true house thermal response. Over months of operation, these coefficients will drift as the thermal characteristics of the house worsen with age. This will be most noticeable with a heating boiler as it becomes fouled through use—**the house will begin to take longer to heat up.**"

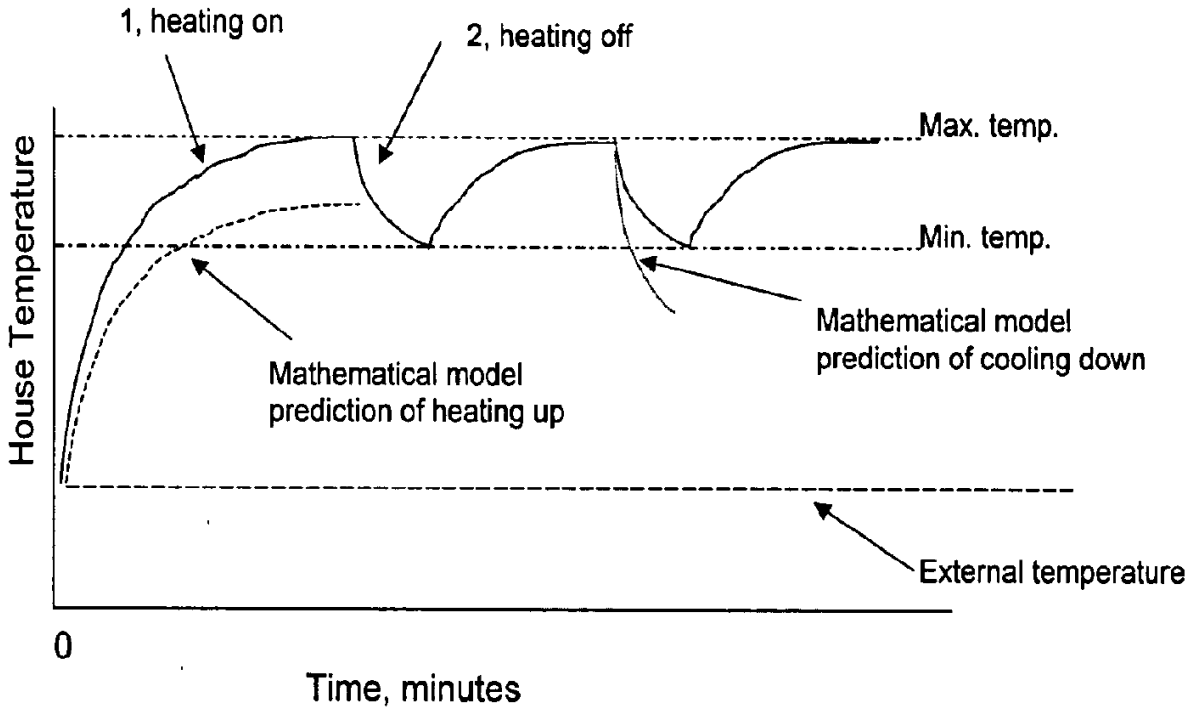
(Ex. 1004, ¶0146)(Emphasis added)(Ex. 1002, ¶108)(*see also* Ex. 1004,

¶0141)("The transient model would be used to determine how fast the house heats up and cools down…."). Oswald further teaches using optimum start / stop calculations, which involve determining how fast the house heats up or cools down. (Ex. 1004, ¶¶0139, 0123-0124, 0103)(Ex. 1002, ¶108).

Determining how fast the house heats up and cools down means determining the **rates of change in temperature at said first location,** where the first location is where temperature is being measured. (Ex. 1002, ¶¶107-109).

By calculating the rate at which the house heats up and cools down, Oswald was teaching to calculate the rate of change in temperature when the **HVAC system** is **'on'** and **'off'**. (Ex. 1002, ¶109). As Mr. Shah explains, if the outside temperature is higher than the inside temperature (a hot summer day), then the rate of *cooling down* is with the HVAC system 'on', whereas the rate of *heating up* is with the HVAC system 'off'. (Ex. 1002, ¶110). If, however, the outside temperature is lower than the inside temperature (a cold winter day), then the rate of heating up is with the HVAC system 'on', whereas the rate of cooling down is with the HVAC system 'off'. (Ex. 1002, ¶110).

This latter case is shown, *e.g.*, in Fig. 8 of Oswald, reproduced below:



(Ex. 1004, Fig. 8, ¶¶0135-0136)(Ex. 1002, ¶111). In Fig. 8, the external temperature is shown by the dashed line near the x-axis of the graph. In other words, the figure reflects a cold day, where the *heating* system would be active. (Ex. 1002, ¶112). The temperature increases when the heating system is on ("1, heating on", upper left), and the temperature decreases when the heating system is off ("2, heating off", upper middle). (Ex. 1004, Fig. 8, ¶¶0135-0136)(Ex. 1002, ¶112).

Thus, Oswald teaches that "the transient model would be used to determine how fast the house heats up and cools down", which in turn teaches calculating rates of change in temperature at said first location when the HVAC system is 'on' and when the HVAC system is 'off'. (Ex. 1002, ¶113).

"[1f] to relate said calculated rates of change to said outside temperature measurements."

Oswald teaches **relat[ing] said calculated rates of change to said outside temperature measurements.** Specifically, Oswald teaches using outside temperature measurements in the transient thermal model. (Ex. 1004, ¶¶0024, claim 27, 0122-0137, Fig. 8)(Ex. 1002, ¶¶114-115). The transient thermal model is then used (*see* element [1e]) to predict the rates of change of temperature when the HVAC system is 'on' and 'off'. (Ex. 1004, ¶¶0141, 0024, claim 27, 0135-0136, Fig. 8)(Ex. 1002, ¶115).

Oswald explains that its EMS includes:

> "a modelling means, which uses the inside and **outside temperature** measurements to derive a transient thermal model of the house, which can predict changes in the inside temperature on the basis of the information about the outside temperature and on the basis of the operation of heating and/or cooling electrical appliances identified as connected to the supply…."

(Ex. 1004, ¶0024, claim 27)(Emphasis added)(Ex. 1002, ¶116).

Because Oswald uses the outside temperature to form and update the transient thermal model, and because the transient model is used to determine how fast the house heats up and cools down (*i.e.* the rates of change when the HVAC system is 'on' and 'off'), Oswald teaches the processor **relating said calculated rates of change to said outside temperature measurements.** (Ex. 1002, ¶117).

CLAIM 4

"4. A system as in claim 1 in which said processors communicate with said HVAC system using a network that includes an electricity meter."

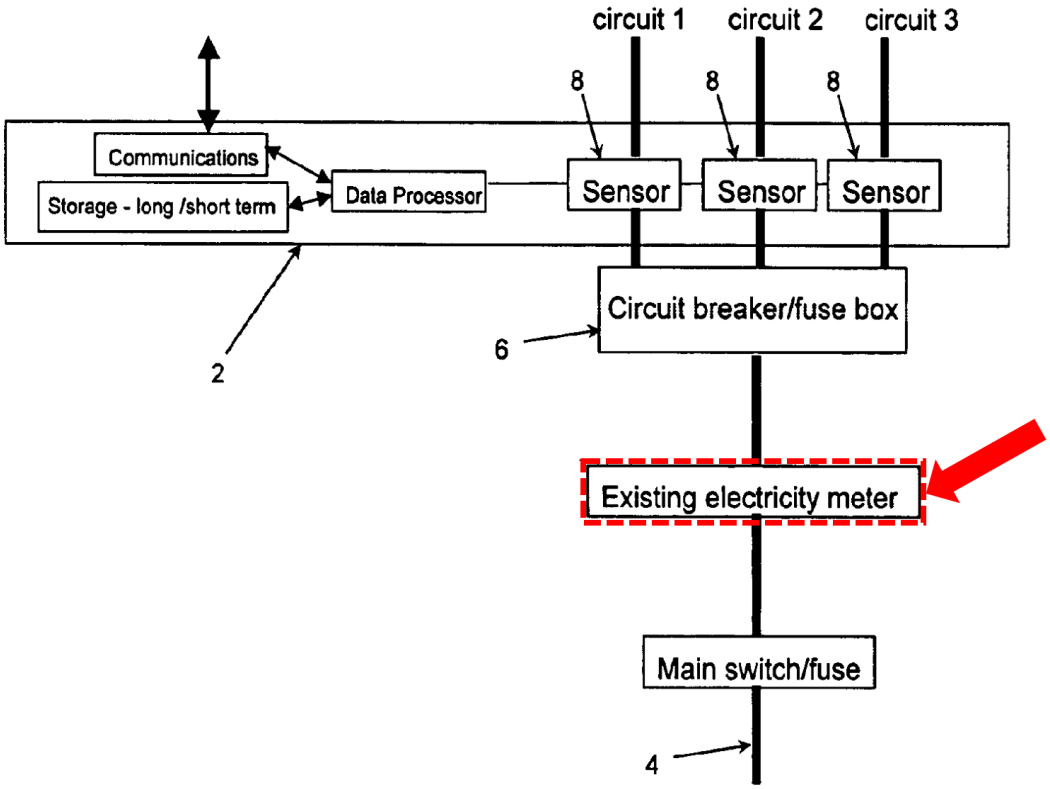
Oswald teaches a **processor that communicates with said HVAC system using a network that includes an electricity meter.** (Ex. 1004, ¶0052)(Ex. 1002, ¶118).

First, Oswald teaches the processor can communicate with the other components of the system (*e.g.* the HVAC system) over a network. Oswald states:

> "The analysis is performed on computers either local to the house or on the Internet. **Communications between the various system items use standard known communication systems i.e. phone, radio, Internet or communication by power cable.**"

(Ex. 1004, ¶0052)(Emphasis added)(Ex. 1002, ¶119).

The various "system items" referred to above can include an electricity meter. (Ex. 1004, Fig. 2, ¶¶0054-0055)(Ex. 1002, ¶120). The electricity meter of Oswald is shown in Fig. 2, reproduced here, with an added red-dashed box and red arrow indicating the meter:



(Ex. 1002, ¶120). As shown in Fig. 2, Oswald's electricity meter is connected to sensors, which are in turn connected to data processing and communication functions. (Ex. 1004, Fig. 2). Furthermore, Oswald states that the processor can communicate with other system components "us[ing] standard known communication systems i.e. phone, radio, Internet or **communication by power cable**." (Ex. 1004, ¶0052)(Ex. 1002, ¶121). The "power cable" includes the electricity meter, as is shown in Figs. 1 and 2, and well-understood in the art. (Ex. 1002, ¶122). Thus, Oswald teaches that the processor **communicate[s] with said HVAC system using a network that includes an electricity meter**. (Ex. 1002, ¶123).

CLAIM 7

The limitations of claim 7 are similar to the limitations of claim 1, except that claim 7 is written in method form, and does not expressly require an HVAC control system. (Ex. 1002, ¶124).

"7[a]. A method for calculating a value for the operational efficiency of an HVAC system that comprises:"

See claim 1, element 1[a], above. (Ex. 1002, ¶125). The system shown in claim 1 also exemplifies a method. (Ex. 1002, ¶125).

"[7b] receiving temperature measurements from at least a first location conditioned by at least one HVAC system;"

See claim 1, element 1[b], above. (Ex. 1002, ¶126).

"[7c] storing in one or more databases at least said temperatures measured at said first location over time;"

See claim 1, element 1[c], above. (Ex. 1002, ¶127).

"[7d] receiving outside temperature measurements from at least one source other than said HVAC system; and"

See claim 1, element 1[d], above. (Ex. 1002, ¶128).

"[7e] calculating with one or more computer processors one or more rates of change in temperature at said first location for periods during which the status of the HVAC system is 'on' and calculating one or more rates of change in temperature at said first location for periods

during which the status of the HVAC system is 'off',"

See claim 1, element 1[e], above. (Ex. 1002, ¶129).

"[7f] where said calculated rates of change are related to said outside temperature measurements."

See claim 1, element 1[f], above. (Ex. 1002, ¶130).

CLAIM 10

"10. A method as in claim 7 that includes receiving information about electricity consumption in said first location from an electricity meter."

Oswald teaches **receiving information about electricity consumption in said first location from an electricity meter**. Specifically, Oswald teaches:

> "Meter Reading [0107] The system builds up and records detailed energy consumption data and by integrating this over time it can record the total energy (kWh) used and so become an energy meter. This allows billing information to be sent to the customer and the utility directly over the communications network, as shown in FIG. 4."

(Ex. 1004, ¶¶0106-0107)(Ex. 1002, ¶131). That is, Oswald teaches acting as an energy meter, from which the system **receives information about electricity consumption**. (*Id.*). The consumption related to "**said first location**", because the first location is in a structure (house) in which Oswald's EMS operates. (Ex. 1002, ¶131).

Ground 2. Claims 1, 3-7, and 9-12 are obvious over Oswald in view of Cler and the knowledge of a person of ordinary skill.

Claims 1, 3-7, and 9-12 are obvious under pre-AIA 35 U.S.C. §§ 103(a) over U.S. Pat. App. Pub. 2005/0171645 ("**Oswald**") (Ex. 1004) in view of U.S. Pat. No. 4,897,798 ("**Cler**") (Ex. 1005) and the knowledge of a person of ordinary skill.

Oswald is applied as in Ground 1, above. Neither Oswald nor Cler were of record during any application leading to the '497 Patent.

A. Effective Prior Art Dates

Oswald is prior art as discussed in Ground 1.

Cler issued on January 30, 1990, and is thus prior art under pre-AIA 35 U.S.C. § 102(b).

B. Overview of the Ground

The combination of Oswald and Cler renders the challenged claims obvious as described in the Overview of the Combination, below. (Ex. 1002, ¶132). To understand the combination, however, a brief overview of the Cler reference is necessary.

1. Overview of Cler

Cler is directed to an "[a]daptive environment control system". (Ex. 1005, Title)(Ex. 1002, ¶137). Cler's control system incorporates measurements of inside temperature and outside weather conditions into a thermal model of a building. (Ex. 1005, 2:10-21)(Ex. 1002, ¶138). Using this model, Cler's system can control the

HVAC system in a more accurate way. (Ex. 1005, 2:10-21)(Ex. 1002, ¶138). Cler explains:

> "The adaptive environment control system can calculate, through the estimates and measurements, the thermal performance of both the building and the HVAC system so that the HVAC system is operational sufficiently early to maintain the building's interior temperature within a predetermined range of the set-point threshold level of the thermostat. The adaptive environment control system can thereby accurately control the interior temperature of the building in spite of changing outside weather conditions and changes in the performance of the HVAC system."

(Ex. 1005, 2:10-21)(Ex. 1002, ¶138). Cler's method of control allows the system to calculate optimum stop and start times for a setback schedule, using the rate of change of temperature inside the building. (Ex. 1005, 6:24-8:20)(Ex. 1002, ¶139).

To accomplish this, Cler makes use of both the rate of change in inside temperature, and the outside temperature to derive a transient thermal model. (Ex. 1005, Eqs. (1)-(2), (4)-(11), 3:39-5:41)(Ex. 1002, ¶¶140-142). From the model, Cler provides a calculation of the time it would take to heat up or cool down the building by a certain number of degrees. (Ex. 1005, 5:1-41, Eqs. (1)-(2), (4)-(11), 3:40-5:41)(Ex. 1002, ¶142). This information is then used to calculate optimum stop and start times. Cler explains the basic concept as follows:

> "[T]he adaptive environment control system can accurately set the

> time at which the HVAC system is switched between the set-back unoccupied hours temperature level and the normal set-point building occupied temperature level, through the estimates of how long it takes both the HVAC system to have an impact on the building temperature as well as **the rate of change of the interior building temperature** based on outside environment conditions**.** These estimates and measurements of the adaptive environment control system provide a more efficient control of the HVAC system as well as an indication of the level of performance of the HVAC system for maintenance purposes."

(Ex. 1005, 2:23-35)(Emphasis added)(Ex. 1002, ¶143).

When performing optimum stop and start calculations, Cler's system first checks whether the time is sufficiently close to a scheduled temperature transition point. (Ex. 1005, 6:38-50)(Ex. 1002, ¶144). If so, the system calculates an optimum stop or start time. To calculate an optimum *stop* time, Cler assumes that the HVAC system is 'off', and calculates the time it would take for the building to reach a setback temperature on its own. (Ex. 1005, 7:17-62)(Ex. 1002, ¶144). To calculate an optimum *start* time, Cler calculates the HVAC system is 'on', and calculates the time needed to drive inside temperature back to the normal setpoint. (Ex. 1005 7:64-8:19)(Ex. 1002, ¶144).

2. The Combination

Although Petitioner believes that Oswald anticipates claims 1, 4, 7, and 10 as

explained in Ground 1, this Ground 2 provides two types of obviousness contentions.

First, obviousness contentions based on Oswald alone (or with reference to Cler or the knowledge of a person of ordinary skill) are provided for limitations 1[b] – [1d]. Specifically, this Ground demonstrates that it would have been obvious to have the HVAC control system receive inside temperature measurements (element [1b]), that it would have been obvious to have the database store inside temperature measurements over time (element [1c]), and that it would have been obvious for the processor to receive outside temperature measurements from a source other than the HVAC system (element [1d]). (Ex. 1002, ¶145).

Second, while Oswald teaches calculating the rates of change of inside temperature with the HVAC system 'on' and 'off' (claim element [1e]), and relating these rates to outside temperature (claim element [1f]), Cler provides the mathematical underpinnings for such calculations in the context of calculating optimum stop and start times. It would have been obvious to use Cler's calculations with Oswald. (Ex. 1002, ¶145).

Other minor obviousness rationales relating to dependent claims are presented below in the claim mapping section where appropriate.

C. Rationale (Motivation) Supporting Obviousness

It would have been obvious to combine Cler with Oswald as discussed in the Overview section. (Ex. 1002, ¶149).

Oswald and Cler both relate to energy management systems that track the efficiency of heating and cooling systems, and are thus in the same field. (Ex. 1004, Abstract)(Ex. 1005, Abstract)(Ex. 1002, ¶149). A POSA, moreover, would have looked to Cler when reviewing Oswald. (Ex. 1002, ¶¶150-151). Oswald describes using a "transient thermal model". (Ex. 1004, ¶¶0024-0025)(The system "uses the inside and outside temperature measurements to derive a transient thermal model of the house.")(Ex. 1002, ¶150). While Oswald's transient thermal model is disclosed *generally*, it is not expressed in mathematical detail. Cler, however, *does* provide the mathematics of a transient thermal model. (*See, e.g.* Ex. 1005, 3:39-5:41)(Ex. 1002, ¶157). Cler's model is a "transient thermal model" because it is based on a balance of the instantaneous flow of heat into and out of the building. (Ex. 1005, 4:17-32)(Ex. 1002, ¶150). It would therefore have been obvious for a person of ordinary skill to examine the mathematics of known transient thermal models when reviewing Oswald. (Ex. 1004, ¶0008)(Ex. 1002, ¶150).

Furthermore, Cler builds on Oswald's own disclosure of a setback schedule with optimum stop and start times. Oswald states:

> "In traditional systems the householder uses a time controller to define when the heating (or air conditioning) should turn on and off. **With the use of the transient thermal model, the householder can now define when the house is to reach the controlled temperature schedule rather than when to start heating**. This allows the single

> central sensor system **to calculate the optimum time to turn on**. For example, say the householder returns home at 17:30 in the evening and wants the house at the desired temperature at 17:30. The system can use the transient model to calculate the time it will take to reach the desired temperature: on a cold windy day this might be 1 hour and on a mild day it might be 30 minutes. In this way the heating system is turned on for the minimum time and the house consumes the minimum heat energy."

(Ex. 1004, ¶0139)(Emphasis added)(Ex. 1002, ¶151).

Cler provides a method for implementing what Oswald teaches, namely a setback schedule with optimum stop and start times. As discussed above in the Overview section, Cler uses its transient thermal model to estimate the time it will take for the building inside temperature to reach a setback point (with the HVAC system 'off'), and to estimate the time it will take to recovery to a normal temperature (with the HVAC system 'on'). (Ex. 1005, 6:24-8:19)(Ex. 1002, ¶152). Cler teaches that its methods "provide a more efficient control of the HVAC system as well as an indication of the level of performance of the HVAC system for maintenance purposes." (Ex. 1005, 2:31-35)(Ex. 1002, ¶159). Thus, because Oswald suggests using optimum stop and start procedures, and Cler provides a detailed proposal for how to implement such procedures with advantage, it would have been obvious for a POSA to do so. (Ex. 1002, ¶153). Additionally, using Cler's mathematics for optimum stop and start in Oswald's system would have

involved using a known technique to improve Oswald in a known way, without unpredictable results (Ex. 1002, ¶153), and would thus also have been obvious under *KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 416-18 (2007).

Additional reasoning concerning motivation to combine or modify is provided in the claim mapping, below, under each element as appropriate.

D. *Graham* Factors

The **level of ordinary skill** encompassed a (1) Bachelor's degree in engineering, computer science, or a comparable field of study, and (2) at least five years of (i) professional experience in building energy management and controls, or (ii) relevant industry experience. Additional relevant industry experience may compensate for lack of formal education or vice versa. (Ex. 1002, ¶¶26-27).

The **scope and content of the prior art** are discussed throughout the Ground.

The **differences between the prior art and the claims** are discussed in the "Overview of the Combination" and in the claim mapping, below.

Petitioner is not aware of any **secondary considerations** that would make an inference of non-obviousness more likely.

E. Reasonable Expectation of Success

A POSA in the art in the relevant timeframe would have had a reasonable expectation of success in combining Oswald and Cler in the manner discussed in the Overview section. (Ex. 1002, ¶¶155-158). As Mr. Shah explains, the art was

relatively predictable in the relevant timeframe (2007). (*Id.*). A POSA would have been able to implement the obviousness modifications in this ground without difficulty. (*Id.*).

F. Analogous Art

Oswald and Cler are analogous art because they are in the same field as the '497 patent (building energy management and controls), and their methods would have been reasonably pertinent to the problems facing the named inventors. (Ex. 1004, Abstract)(Ex. 1005, Abstract)(Ex. 1002, ¶¶149, 159). *See Wyers*, 616 F.3d at 1238.

G. Claim Mapping

This section maps the challenged claims to the relevant disclosures of Oswald and Cler, where the claim text appears in bold-italics, and the relevant mapping follows the claim text. The Petitioner has added numbering and lettering in brackets (*e.g.* [1a], [1b]) to certain claim elements, to facilitate the discussion.

Independent Claim 1

"1[a]. A system for calculating a value for the operational efficiency of a heating, ventilation, and air conditioning (HVAC) system comprising:"

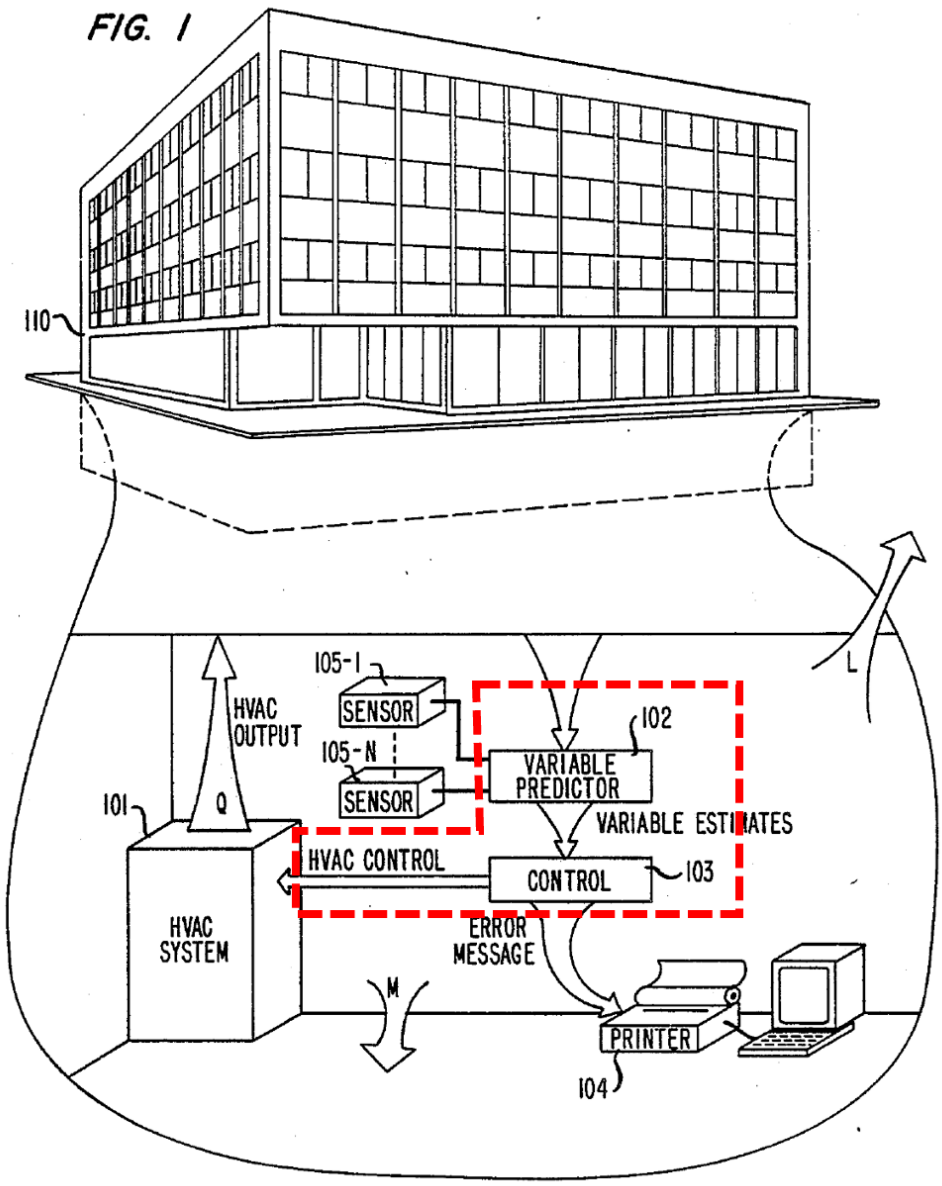
As discussed above under Ground 1, claim element 1[a], Oswald teaches a system **for calculating a value for the operational efficiency of a heating, ventilation, and air conditioning (HVAC) system**. (Ex. 1004, Abstract, ¶¶0036,

0146, 0024-0025)(Ex. 1002, ¶161).

"[1b] at least one HVAC control system that receives temperature measurements from at least a first location conditioned by at least one HVAC system;"

As discussed above under Ground 1, claim element [1b], Oswald teaches **at least one HVAC control system that receives temperature measurements from at least a first location conditioned by at least one HVAC system**. (Ex. 1002, ¶162).

Cler likewise teaches an HVAC control system, in the form of variable predictor 102 and control system 103, as shown by the added red-dashed box in Fig. 1 of Cler, reproduced here:



As can be seen from Fig. 1 of Cler, the HVAC control system receives input from sensors 105-1 through 105-N. Among these are sensors that sense inside temperature. Cler explains:

> "The adaptive environment control system of the present invention is illustrated in block diagram form in FIG. 1…. **The control elements consist of various sensor devices 105-l to 105-n, such as**

> **thermostats and humidity sensors. Variable predictor 102 is connected to the various sensor devices 105-l to 105-n to obtain measurements of the building environment**."

(Ex. 1005, 2:44-54)(Emphasis added)(Ex. 1002, ¶¶163-165).

Although already taught by Oswald, it would further have been obvious to have Oswald's HVAC control system receive inside temperature measurements from a first location. (Ex. 1002, ¶166). Oswald teaches using a thermostat (Ex. 1004, ¶0148), and it was customary for thermostats to have a temperature sensor as, for example, Cler teaches and the '497 patent admits. (Ex. 1005, 1:13-22)(Ex. 1001, 1:25-35)(Ex. 1002, ¶167). And as noted above under Ground 1, claim element [1b], Oswald teaches that the thermostat communicates information to the sensor 2 to allow the sensor 2 to determine when temperature limits have been reached and adjust the transient thermal model to better fit the thermal response (*i.e.* the temperature). (Ex. 1004, ¶0148)(Ex. 1002, ¶167). A POSA would have found it obvious to have the sensor 2 (HVAC control system) receive temperature measurements to allow the sensor 2 to better perform these functions. (Ex. 1002, ¶167).

Similarly, Oswald teaches that the HVAC control system (sensor 2) is controlling the HVAC system to adjust temperature for the comfort of the occupants. (Ex. 1004, ¶¶0101, 0139, 0098-0100, 0016)(Ex. 1002, ¶168). An obvious way to do

this was the standard way known in the art, namely by having a target temperature (setpoint) and switching the HVAC system 'on' or 'off' until the target is reached, as taught by Cler and admitted by the '497 patent. (Ex. 1005, 1:17-51)(Ex. 1001, 1:25-35)(Ex. 1002, ¶168). Oswald likewise teaches that the sensor 2 performs an optimum start / stop function. To accomplish these activities, it would also have been obvious to have the HVAC control system (sensor 2) receive inside temperature measurements, to allow the HVAC control system (sensor 2) to better control the HVAC system (*e.g.* to stop when the HVAC system when the desired temperature is reached)(Ex. 1002, ¶168).

Furthermore, Oswald states that its system uses inside temperature measurements from an inside temperature sensor to construct a transient thermal model of the house. (Ex. 1004, ¶¶0024, claim 27, 0131, 0127-0136)(Ex. 1002, ¶169). It would have been obvious for inside temperature to have been received by the HVAC control system, because the HVAC control system is the hub that collects information from all other elements of the system, as shown in Fig. 3 of Oswald, reproduced below:

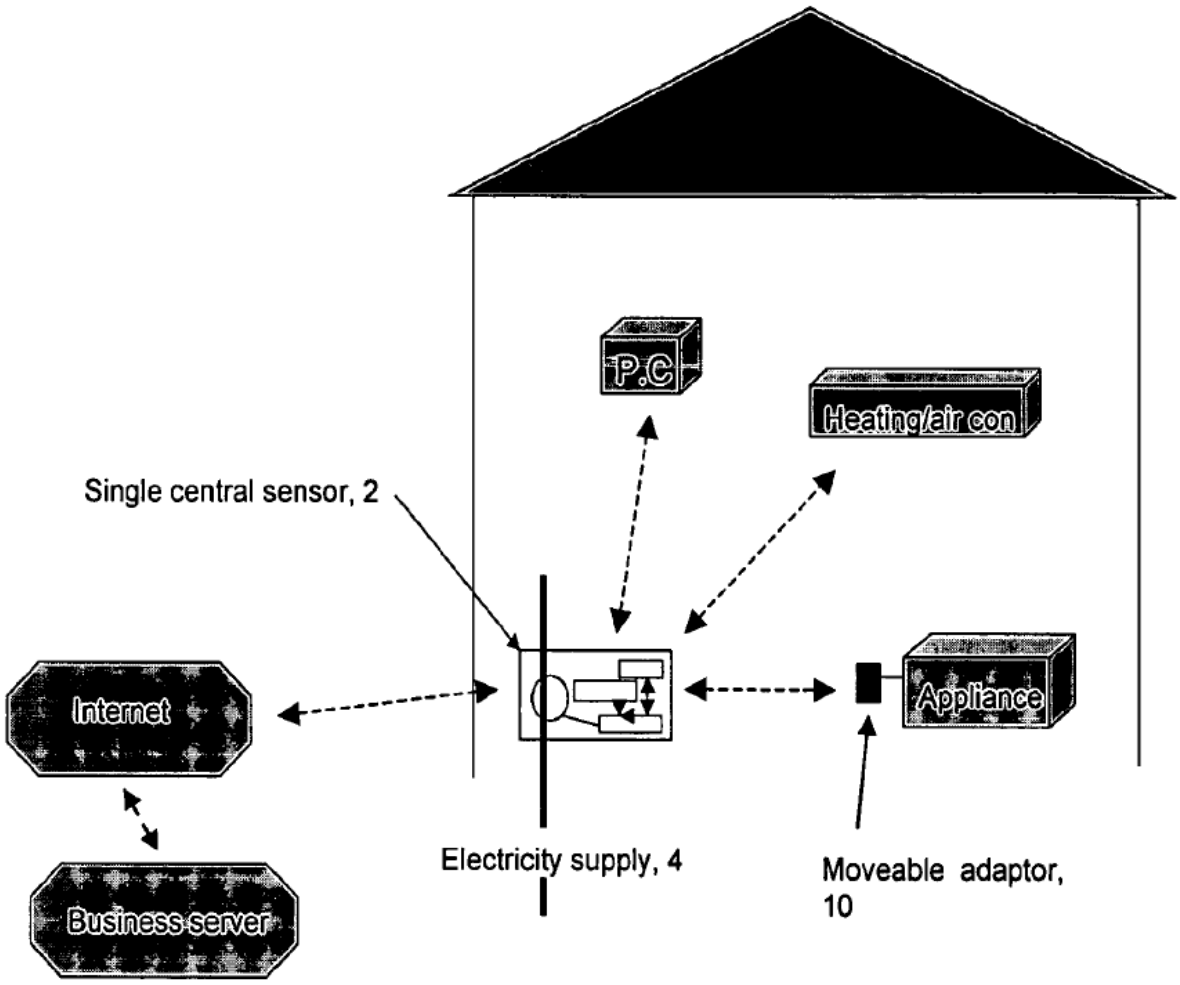


Figure 3

(Ex. 1002, ¶169). It would have been obvious from Fig. 3 to have the single central sensor 2 act as the central point for all communications, with no components communicating with other components but through the sensor 2. (Ex. 1002, ¶169). Thus, from Fig. 3, a POSA would have found it obvious to transmit temperature measurements from the single central sensor 2 to the PC (processor). (Ex. 1002,

¶169).

Because Oswald teaches that its sensor 2 receives information from a thermostat, performs HVAC control operations, and also suggests that it serve as a communications hub, it would have been obvious based on Oswald and Cler to have Oswald's HVAC control system (sensor 2) **receive temperature measurements from at least a first structure conditioned by at least one HVAC system.** This would have had the advantage of allowing the sensor 2 to better control the HVAC system for user comfort. (Ex. 1002, ¶¶170-171).

"[1c] one or more databases that store at least said temperatures measured at said first location over time; and"

As discussed above under Ground 1, claim element [1c], Oswald teaches **one or more databases that store at least said temperatures measured at said first location over time**. (Ex. 1002, ¶172).

It furthermore would have been obvious based on Oswald's teachings to have Oswald's database store **at least said temperatures measured at said first location over time**. This is both because Oswald teaches that the database stores "acquired data" (and data from temperature sensors is "acquired"), and because a POSA would have understood Oswald to be using temperature data over time in aligning the transient thermal model to the real thermal response. (Ex. 1004, Fig. 8, ¶¶0135-0136)(Ex. 1002, ¶¶71, 88, 173). Because Oswald uses temperature measured at said

first location over time in the transient thermal model, it would have been obvious to store that information in the storage facility provided by Oswald: the database. (Ex. 1004, ¶0059)(Ex. 1002, ¶173).

"[1d] one or more processors that receive outside temperature measurements from at least one source other than said HVAC system,"

As discussed above under Ground 1, claim element 1[d], Oswald teaches **one or more processors that receive outside temperature measurements from at least one source other than said HVAC system**. (Ex. 1002, ¶174).

It furthermore would have been obvious based on Oswald's teachings to have the outside temperature come **from at least one source other than said HVAC system.** (Ex. 1002, ¶175). Oswald states that:

> "The system can use network data to improve validity. For example it can be informed of **local weather** from existing Internet weather databases which have weather information from nearby weather stations."

(Ex. 1004, ¶0137)(Ex. 1002, ¶175). A POSA would have considered outside temperature to be a necessary and obvious part of local weather data, and would have understood "validity" in the above quote to pertain to the need to incorporate outside temperature into a transient thermal model (because without taking outside temperature into account, the model is invalid). (Ex. 1002, ¶175).

Oswald further states:

> "The household energy management system according to the second aspect of the invention may further comprise one or more temperature sensors for measuring the temperature inside the house; **a source of information about the temperature outside the house**; a modelling means, which uses the inside and outside temperature measurements to derive a transient thermal model of the house…."

(Ex. 1004, ¶0024, claim 27)(Emphasis added)(Ex. 1002, ¶176). In the passage above, the inside temperature comes from a temperature sensor inside the house, whereas the outside temperature comes from "a source of information about the temperature outside the house." This contrast suggests that the information about outside temperature does not come from a sensor that is part of the HVAC system, but rather an outside source. (Ex. 1002, ¶176). Note again that the claim requires that the source of outside temperature be "other than said HVAC system", and not "other than said HVAC control system".

Oswald's teachings (1) to use outside temperature, (2) that outside temperature (in contrast to inside temperature) can be taken from "a source of information about the temperature outside the house", and (3) that the system can access local weather information to improve the validity of the data, would have made it obvious to a person of ordinary skill in the art to a) either obtain temperature from some local source (such as a sensor) other than from the HVAC system, or b)

use local weather data to provide a measurement of outside temperature. The latter option would have had the advantages of avoiding the cost of an extra sensor, and improving the accuracy of the data through the use of professionally-maintained temperature sensing equipment from a weather service, and could have been implemented without unpredictable results. (Ex. 1002, ¶177).

Finally, the processor discussed above would obviously **receive the measurement of outside temperature** from local weather data, because the processor performs the analysis for the EMS, including of the transient thermal model, and thus would require the measurement of outside temperature. (Ex. 1004, ¶0052)(*see also* Ex. 1004, ¶¶0046-0057)(Ex. 1002, ¶178).

"[1e] wherein said one or more processors are configured to calculate one or more rates of change in temperature at said first location for periods during which the status of the HVAC system is 'on' and wherein said one or more processors are further configured to calculate one or more rates of change in temperature at said first location for periods during which the status of the HVAC system is 'off', and"

As discussed above under Ground 1, claim element 1[e]. Oswald teaches **one or more processors that calculate the rates of change in temperature at said first location when the HVAC system is 'on' and when it is 'off'**. (Ex. 1002, ¶179).

Furthermore, it would have been obvious to calculate the claimed rates of change based on Oswald and Cler for two independent reasons, one based on Oswald

alone, and one based on Oswald in view of Cler. (Ex. 1002, ¶180).

The **first** reason is based on Oswald alone. As discussed above under Ground 1, claim element 1[e], Oswald teaches determining how fast the house heats up or cools down, which are the claimed rates of change of temperature. (Ex. 1004, ¶¶0143, 0146, 0141)(Ex. 1002, ¶181). These rates of change are furthermore for when the HVAC system is 'on' and when it is 'off', for the reasons explained above under Ground 1, claim 1, element [1e]. (Ex. 1002, ¶181). However, it also would have been obvious to determine the relevant rates of change because Oswald teaches using a setback schedule with optimum start / stop. (Ex. 1004, ¶¶0139, 0123-0124, 0103)(Ex. 1002, ¶182). To do so, it would have been obvious to calculate the best time to stop the HVAC system for setback, and the best time to start the HVAC system for subsequent recovery. (Ex. 1002, ¶182). To calculate these times, it would have been obvious to know *how fast* the house would cool down and heat up, *i.e.* to use rates of change in temperature when the HVAC system is 'on' and 'off'. (Ex. 1002, ¶182). Knowing these rates allows Oswald's system to calculate the length of time necessary to heat or cool the house to the setback or recovery temperatures. (Ex. 1002, ¶183). As Mr. Shah explains, by knowing an estimate of the rate of change in temperature, one can divide a desired temperature difference by the rate of change to get the time required to cause the change in temperature, according to the following general formula: $\Delta t = \Delta T / (dT/dt)$, where Δt is the time

it will take to effect the desired change in temperature, ΔT is the desired change in temperature, and dT/dt is the rate of change in temperature. (Ex. 1002, ¶183). Such an estimate would obviously have used a different rate of change (dT/dt) depending on whether the HVAC system was 'on' or 'off', *i.e.* whether the optimum stop time prior to setback, or the optimum start time prior to recovery, was being calculated. (Ex. 1002, ¶183). This is basic mathematics, and well within ordinary skill in the relevant timeframe. (Ex. 1002, ¶184).

The **second** reason is based on Oswald in combination with Cler. Specifically, it would have been obvious to calculate the claimed rates of change using Cler's method. (Ex. 1002, ¶184). As discussed above in the section entitled "Overview of Cler" (beginning on page 40, above), Cler teaches using a setback and recovery schedule with optimum start / stop times (Ex. 1005, 6:24-8:19)(Ex. 1002, ¶184). To calculate these times, Cler uses estimates of the rate of change in temperature at the first location. Cler teaches:

> "In addition, the adaptive environment control system can accurately set the time at which the HVAC system is switched between the set-back unoccupied hours temperature level and the normal set-point building occupied temperature level, through the estimates of how long it takes both the HVAC system to have an impact on the building temperature as well as the **rate of change of the interior building temperature based on outside environment conditions**."

(Ex. 1005, 2:22-2:35)(Emphasis added)(Ex. 1002, ¶184). As in Oswald, it was obvious that the rate of change in house temperature during setback was with the HVAC system 'off', whereas the rate of change in house temperature during recovery to normal temperature was with the HVAC system 'on'. (Ex. 1005, 6:46-7:7 (for setback), 7:65-8:19 (for recovery))(Ex. 1002, ¶184).

Using the rate of change in a setback and recovery application, Cler teaches a simplified way to calculate the time it would take to change the temperature of the conditioned building to a setpoint temperature. (Ex. 1005, 5:6-41)(Ex. 1002, ¶185). Specifically, Cler solves its Eq. (7) for time by using a Taylor series estimate of the exponential solution for $T_{in}(t)$. (Ex. 1005, 5:6-41)(Ex. 1002, ¶185). This results in an expression for the time needed to go from a current temperature to a setpoint, expressed in Eq. (11), reproduced here:

$$t = \frac{T_{set} - T_{in}(t)}{k(T_{out}(t) + \gamma - T_{in}(t))}$$

(Ex. 1005, 5:27-41)(Ex. 1002, ¶185).

In this Eq. (11), the denominator on the right-hand side of the equation is the **rate of change in temperature at a first location.** (Ex. 1002, ¶186). Specifically, 't' (on the left side) is "the amount of time for the building temperature to cycle to the set point/back temperature", which we can write as **Δt**. (Ex. 1005, 5:31-35)(Ex.

1002, ¶186). Furthermore, $T_{in}(t)$ (right side) is the inside temperature evaluated at start time t, while (right side) T_{set} is the desired setpoint temperature. (Ex. 1002, ¶186). Thus, the numerator on the right side of Eq. (11) (which is T_{set} - $T_{in}(t)$) represents the difference between the desired setpoint temperature and the current temperature, or the number of degrees by which the system desires to change the inside temperature. (Ex. 1002, ¶186). We can write this as **ΔT**. Thus, Eq. (11) has the form $\Delta t = \Delta T / D$, or written out: the change in time equals the change in temperature divided by a denominator D (which is $k(T_{out}(t) + \gamma - T_{in}(t))$. By solving for the denominator D, it can be seen that $D = \Delta T / \Delta t$. (Ex. 1002, ¶186). In other words, the denominator D of Eq. (11) is a **rate of change in temperature** (the desired change in inside temperature divided by the time it takes to make the change). (Ex. 1002, ¶186).

In order to estimate the amount of time it would take to change the temperature by a desired amount using Eq. (11), it would be obvious to have the processor calculate the denominator D, as Cler obviously did. (Ex. 1005, 5:27-41)(Ex. 1002, ¶187). The denominator D is the rate of change in temperature **at said first location** (in the house, where the temperature sensor is located). (Ex. 1005, 3:39-60, 4:10-11)(Ex. 1002, ¶187). It furthermore would have been obvious to calculate the rates of change in temperature in the denominator of the right side of Eq. (11) of Cler, in order to then calculate the necessary amount of time to make a desired temperature

change, and thus to calculate optimal stop and start times. (Ex. 1002, ¶187).

The rate of change from Eq. (11) (the denominator on the right-hand side) applies both when **the HVAC system is on and when it is off**. Specifically, Cler teaches that the parameter 'γ' relates to the amount of heat that the HVAC system adds to the building interior compared to the outflow of heat from the building. (Ex. 1005, 4:54-57). Cler explains that γ can be set to zero when the HVAC system is 'off':

> "Thus, by determining a reasonable estimate of the parameters k and γ, an approximation of the temperature in the building at time t in the future is determinable. A particular application of this capability is the above-mentioned optimal start/stop capability. For this application, the amount of time for the building temperature to cycle to the set point/back temperature is: [Eq. (11) omitted] For short time intervals, $T_{out}(t)$ is approximately a constant and the equation is reduced in complexity. In addition, **for the case of the unoccupied building with the HVAC system off, γ=0 since Q=0**."

(Ex. 1005, 5:27-41)(Emphasis added)(Ex. 1002, ¶188). The variable Q, in Eq. (11) represents "the thermal output of the HVAC system". (Ex. 1005, 4:14-16, 3:21)(Ex. 1002, ¶191). In other words, when the HVAC system is 'off' γ equals zero, because there is no output from the HVAC system. (Ex. 1002, ¶188). Conversely, when the HVAC system is 'on', γ has a value other than zero, because there is some output from the HVAC system. (Ex. 1002, ¶188). The fact that γ is included at all in Eq.

(11) indicates that the HVAC system can be 'on' for certain calculations of Eq. (11), and the fact that Cler states that $\gamma=0$ for the case where the HVAC system is 'off' indicates that the HVAC system can be 'off' for certain calculations of Eq. (11). (Ex. 1002, ¶188). This was also obvious from the fact that Eq. (11) can be used to estimate the time needed for both the optimum stop and the optimum start, which require the HVAC system to be 'off' and 'on' respectively (as explained above). (Ex. 1002, ¶188).

A POSA would reasonably have expected success in calculating one or more rates of change in temperature at said first location for periods during which the status of the HVAC system is 'on' and 'off' based on either Oswald or Cler, because calculating rates of change involved relatively simple mathematics that could have been performed without unpredictable results. (Ex. 1002, ¶189).

It would have been obvious to use the equations of Cler in Oswald for the reasons provided above in the "Rationale" section, beginning on page 43. (Ex. 1002, ¶197).

Thus, Oswald in view of Cler renders obvious calculating one or more rates of change in temperature at said first location for periods during which the status of the HVAC system is 'on' and when the system is 'off', because (1) Oswald renders this obvious based on its own teachings (2) Cler renders this obvious by providing a calculation for the time necessary for either optimum start or stop that utilizes the

rate of change of inside temperature when the HVAC system is 'on' and when it is 'off'. (Ex. 1002, ¶191).

"[1f] to relate said calculated rates of change to said outside temperature measurements."

As explained above in Ground 1, claim element [1f], Oswald teaches **relat[ing] said calculated rates of change to said outside temperature measurements.** (Ex. 1002, ¶192).

This claim element is further obvious based on Cler. Specifically, Cler teaches that its methods use a measurement of outside temperature within its model calculations that lead to its calculation of optimum start and stop times. (Ex. 1002, ¶193). For example, Cler's equation for the rate of heat transfer of the building to the surrounding environment, Eq. (2), uses the difference between the indoor temperature ($T_{i,in}(t)$) and outdoor temperature ($T_{i,out}(t)$) at each surface i:

$$L = \sum_{i}^{\text{all surfaces}} U_i A_i [T_{i,in}(t) - T_{i,out}(t)]$$

(Ex. 1005, 3:62-4:13)(Ex. 1002, ¶193). The outside temperature is similarly used, together with inside temperature, in Eqs. (7)-(11) of Cler. (Ex. 1005, 5:1-41)(Ex. 1002, ¶193). For example, Eq. (11) has in the denominator of the right-hand side (which is the rate of change in temperature as discussed above under claim element

[1e]), the term $k(T_{out}(t) + \gamma - T_{in}(t)$, where $T_{out}(t)$ is the outside temperature measurement. (Ex. 1005, 5:27-41, 4:12-13)(Ex. 1002, ¶193). Thus, Cler further teaches relating said calculated rates of change to said outside temperature measurements.

It would have been obvious to use these equations of Cler for the reasons provided above under claim element [1e] and in the "Rationale" section, beginning on page 43. (Ex. 1002, ¶194).

CLAIM 3

"3. A system as in claim 1 further comprising a programmable thermostat that communicates with said HVAC control system using the Internet."

Oswald in view of Cler renders obvious a **programmable thermostat that communicates with said HVAC control system using the Internet**. First, Oswald teaches using a **thermostat**. (Ex. 1004, ¶¶0136, 0140-0141, 0148)(Ex. 1002, ¶¶195-196).

It would further have been obvious to use a **programmable** thermostat. Programmable thermostats were well-known in the relevant timeframe as taught by Cler, and would have included a microprocessor and allowed for user-determined protocols for temperature vs. time (*e.g.* setback) functionality. (Ex. 1005, 1:23-30)(Ex. 1002, ¶196). Because it would have been obvious to use a setback functionality as discussed above in the Rationale (Motivation) Supporting

Obviousness section, above, it likewise would have been obvious to use a programmable thermostat with setback functionality. (Ex. 1002, ¶196).

Oswald further states that its system components can communicate over the **Internet**:

> "Communications between the **various system items** use standard known communication systems i.e. phone, radio, **Internet** or communication by power cable."

(Ex. 1004, ¶0052)(Emphasis added)(Ex. 1002, ¶197). Oswald specifically teaches that the sensor 2 (part of the EMS) can be made to communicate with a thermostat. (Ex. 1004, ¶0148)(Ex. 1002, ¶197).

Thus, Oswald in view of Cler renders obvious a programmable thermostat communicating with said HVAC control system using the Internet. (Ex. 1002, ¶198).

CLAIM 4

"4. A system as in claim 1 in which said processors communicate with said HVAC system using a network that includes an electricity meter."

As explained above in Ground 1, claim 4, Oswald teaches that **said processors communicate with said HVAC system using a network that includes an electricity meter.** (Ex. 1004, ¶¶ 0052, 0054-0055, Fig. 2)(Ex. 1002, ¶199).

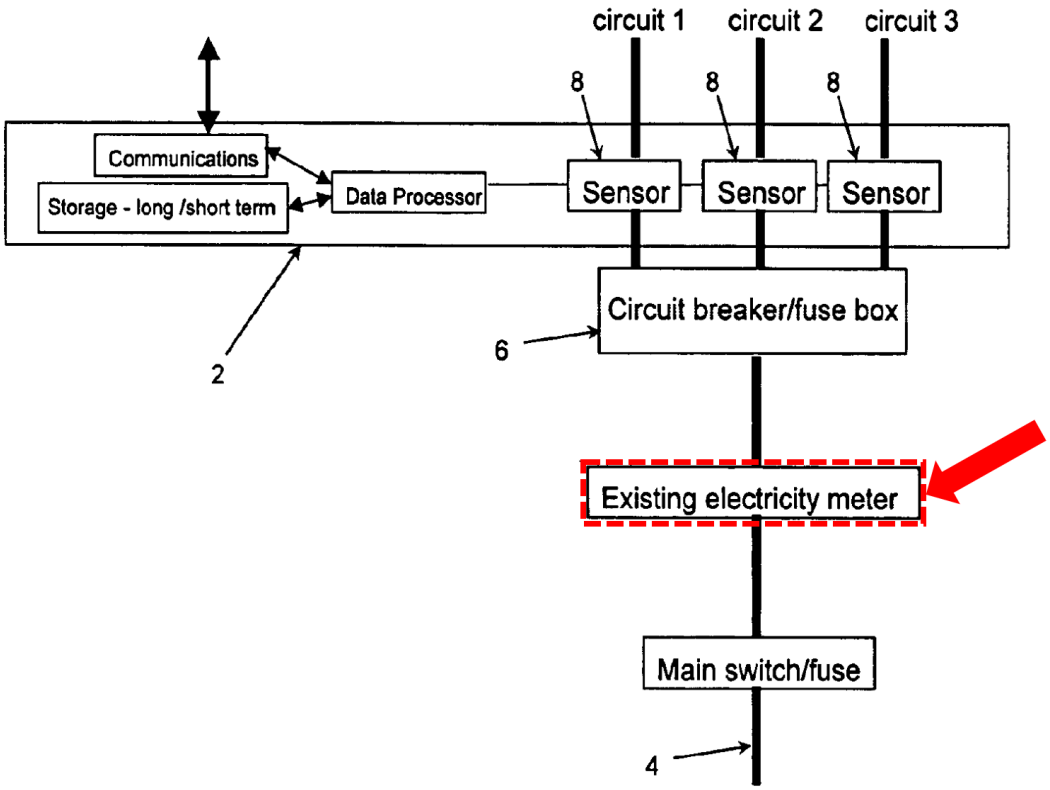
This claim would furthermore have been obvious over Oswald. Oswald teaches the processor can communicate with the other components of the system

(*e.g.* the HVAC system) over a network. (Ex. 1002, ¶200). Oswald states:

> "**The analysis is performed on computers** either local to the house or on the Internet. **Communications between the various system items use standard known communication systems i.e. phone, radio, Internet or communication by power cable.**"

(Ex. 1004, ¶0052)(Emphasis added)(Ex. 1002, ¶200).

The electricity meter of Oswald is shown in Fig. 2, reproduced here, with an added red-dashed box and red arrow indicating the meter:



(Ex. 1002, ¶201). As shown in Fig. 2, Oswald's electricity meter is connected to sensors, which are in turn connected to data processing and communication functions. (Ex. 1004, Fig. 2)(Ex. 1002, ¶201). Furthermore, Oswald states that the

processor can communicate with other system components "us[ing]standard known communication systems i.e. phone, radio, Internet or communication **by power cabl**e." (Ex. 1004, ¶0052)(Ex. 1002, ¶202). It would have been obvious based on these disclosures for Oswald's processor to **communicate with said HVAC system using a network that includes an electricity meter**. (Ex. 1002, ¶202)

Furthermore, Oswald states that the system itself can function as an electricity meter:

> **"A household energy management system** in accordance with the invention, which monitors the energy consumption of household appliances, **can also act as an electricity meter** and may indicate the electricity consumption reading to the householder or transmit the reading directly to the electricity provider."

(Ex. 1004, ¶0026)(Emphasis added)(Ex. 1002, ¶203). Obviously, a system that acts as the electricity meter communicates with an HVAC system over a network that includes an electricity meter.

CLAIM 5

"5. A system as in claim 1 further comprising a programmable thermostat and said programmable thermostat is the sole source for current data regarding temperature inside said location conditioned by said HVAC system."

As explained above in Ground 2, claim 3, Oswald in view of Cler renders obvious **a programmable thermostat that communicates with said HVAC**

control system using the Internet. (Ex. 1002, ¶204).

Oswald further renders obvious that the thermostat is the **sole source for current data regarding temperature inside said location conditioned by said HVAC system**. Specifically, Oswald teaches the use of "**one or more temperature sensors** for measuring the temperature inside the house." (Ex. 1004, ¶0024)(Emphasis added)(Ex. 1002, ¶205). The disclosure of "one or more" temperature sensors discloses a single temperature sensor. (Ex. 1002, ¶216)(Ex. 1001, 1:23-52)(Ex. 1002, ¶205). Furthermore, in the case of a smaller building such as a house (disclosed by Oswald, Ex. 1004, at ¶¶0001, 0012-0018), it would make sense to have only a single temperature sensor in the thermostat. (Ex. 1002, ¶206). As Mr. Shah explains, it was (and is) typical practice to have a thermostat with a single, built-in internal temperature sensor for HVAC systems. (Ex. 1002, ¶206)(Ex. 1008, 1:17-36). A single temperature sensor was typically used to keep costs low, and because multiple temperature sensors within a small wall-mounted unit would be close together, and thus expected to read the same temperature. (Ex. 1002, ¶206). Thus, for those users desiring the cost-saving and other enhanced features of Oswald in a residence that requires only a single temperature sensor, it would have been obvious to use a single thermostat with a single temperature sensor therein. (Ex. 1002, ¶206).

CLAIM 6

"6. A system as in claim 1 in which said temperature measurements inside said first location occur at only one physical location."

See above, claim 5. A single temperature sensor within a single thermostat would typically be wall-mounted, and thus take **temperature measurements at only one physical location**. (Ex. 1002, ¶207).

CLAIM 7

The limitations of claim 7 are similar to the limitations of claim 1, except that claim 7 is written in method form, and does not expressly require an HVAC control system. (Ex. 1002, ¶208).

"7[a]. A method for calculating a value for the operational efficiency of an HVAC system that comprises:"

See the discussion under Ground 2, claim 1, element 1[a], above. (Ex. 1002, ¶212). The system shown in claim 1 also exemplifies a method. (Ex. 1002, ¶209).

"[7b] receiving temperature measurements from at least a first location conditioned by at least one HVAC system;"

See the discussion under Ground 2, claim 1, element 1[b], above. (Ex. 1002, ¶210).

"[7c] storing in one or more databases at least said temperatures measured at said first location over time;"

See the discussion under Ground 2, claim 1, element [1c], above. (Ex. 1002, ¶211).

"[7d] receiving outside temperature measurements from at least one source other than said HVAC system; and"

See the discussion under Ground 2, claim 1, element [1d], above. (Ex. 1002, ¶212).

"[7e] calculating with one or more computer processors one or more rates of change in temperature at said first location for periods during which the status of the HVAC system is 'on' and calculating one or more rates of change in temperature at said first location for periods during which the status of the HVAC system is 'off',"

See the discussion under Ground 2, claim 1, element [1e], above. (Ex. 1002, ¶213).

"[7f] where said calculated rates of change are related to said outside temperature measurements."

See the discussion under Ground 2, claim 1, element [1f], above. (Ex. 1002, ¶214).

CLAIM 9

"9. A method as in claim 7 where said temperature measurements from at least a first location conditioned by at least one HVAC system further are received from a programmable thermostat that communicates with said HVAC control system using the Internet."

See the discussion above under Ground 2, claim 3. Claim 9 differs from claim

3, in that claim 9 further requires that **said temperature measurements from at least a first location** are **received**….**using the Internet**. However, the same reasoning applied for claim 3 also applies for claim 9, because Oswald's thermostat has a temperature sensor (*see* claim 1, element [1b], above), and Oswald expressly discloses that its system components can communicate using the Internet. (Ex. 1004, ¶¶0148, 0052)(Ex. 1002, ¶215).

CLAIM 10

"10. A method as in claim 7 that includes receiving information about electricity consumption in said first location from an electricity meter."

See Ground 2, claim 10, above. (Ex. 1002, ¶216).

CLAIM 11

"11. A method as in claim 7 in which said data regarding temperature inside said location conditioned by said HVAC system is supplied by a programmable thermostat."

See discussion above under Ground 2, claim 5, which has the same claim language in system form. (Ex. 1002, ¶217).

CLAIM 12

"12. A method as in claim 7 in which said temperature measurements at said first location occur at only one physical location."

See discussion above under Ground 2, claim 6, which has the same claim language in system form. (Ex. 1002, ¶218).

Ground 3. Claims 2 and 8 are obvious as in Ground 2 in further view of Rosen

Claims 2 and 8 are obvious under pre-AIA 35 U.S.C. § 103(a) as in Ground 2, in further view of U.S. Pat. No. 6,789,739 ("**Rosen**")(Ex. 1010).

Oswald and **Cler** were discussed in Ground 2.

Rosen was cited in an IDS (together with 78 other references) during the prosecution of the application that issued as the '497 patent, but was never discussed or applied on the record. (Ex. 1011, pp. 87-90). Rosen was cited by an Examiner in a rejection of an alleged parent application of the '497 patent (U.S. Pat. App. Ser. No. 12/211,733, Ex. 1013, pp. 68-71). However, that application issued as a different patent (U.S. Pat. No. 7,848,900), and the Applicants did not contest the Examiner's rejection, but instead simply canceled the rejected claims. (Ex. 1013, p. 58).

A. Effective Prior Art Date of Rosen

Rosen issued on September 14, 2004, and is therefore also prior art under pre-AIA 35 U.S.C. § 102(b).

B. Overview of the Ground

Oswald and Cler are applied as in Ground 2.

Claims 2 and 8 of the '497 patent require "receiv[ing] outside temperatures for geographic regions based on ZIP codes". Oswald and Cler do not expressly teach using weather that is localized using a ZIP code, but Rosen does. It would have been

obvious to combine Rosen's teaching of weather by ZIP code with Oswald's system for the reasons provided below. (Ex. 1002, ¶224).

C. Rationale (Motivation) Supporting Obviousness

The rationales to combine Oswald and Cler with Rosen are provided below in the Claim Mapping section, as appropriate.

D. *Graham* Factors

The **level of ordinary skill** was discussed under Ground 2.

The **scope and content of the prior art** are discussed throughout the Ground.

The **differences between the prior art and the claims** are discussed in the "Overview of the Combination" and in the claim mapping, below.

Petitioner is not aware of any **secondary considerations** that would make an inference of non-obviousness more likely.

E. Reasonable Expectation of Success

A POSA in the relevant timeframe would have had a reasonable expectation of success in combining Oswald, Cler and Rosen in the manner discussed in the Overview section. (Ex. 1002, ¶¶226-229). As Mr. Shah explains, the art was relatively predictable in the relevant timeframe (early 2007). (Ex. 1002, ¶228). A POSA would have been able to integrate Rosen's use of ZIP codes into Oswald. (Ex. 1002, ¶229).

F. Analogous Art

In addition to the explanation provided in Ground 2, Rosen is analogous art

because it is in the same field as the '497 patent (building energy management and controls), and its methods would have been reasonably pertinent to the problems facing the named inventors. (Ex. 1010, 2:1-38)(Ex. 1002, ¶230). *See Wyers*, 616 F.3d at 1238.

G. Claim Mapping

This section maps the challenged claims to the relevant disclosures of Oswald, Cler and Rosen, where the claim text appears in bold-italics, and the relevant mapping follows the claim text.

CLAIMS 2 AND 8

Claims 2 and 8 have similar requirements, and will be addressed together.

"2. A system as in claim 1 in which said processors receive outside temperatures for geographic regions based on ZIP codes from sources other than said HVAC system."'

"8. A method as in claim 7 in which said outside temperatures are received for geographic regions based on ZIP codes from sources other than said HVAC system."

Oswald discloses that its system can receive local weather information over the Internet. Oswald states:

> "The system can use network data to improve validity. For example it can be informed of **local weather from existing Internet weather databases** which have weather information from nearby weather stations."

(Ex. 1004, ¶0137)(Emphasis added)(Ex. 1002, ¶233). As discussed above under Ground 2, claim element [1c], it was obvious to use weather information to provide outside temperature. (Ex. 1002, ¶233).

Oswald does not expressly state that its weather service provider localizes data using a ZIP code. Rosen, however, teaches a thermostat that receives location-specific weather data (including temperature) from a weather service, over the Internet, by providing a ZIP code. (Ex. 1010, 7:19-45, 6:50-61, 2:31-38, 7:58-8:41)(Ex. 1002, ¶234).

Because Oswald teaches retrieving "local" weather data from an Internet weather service provider, but does not specify a way to localize the data, the person of ordinary skill would have sought out known means for doing so. (Ex. 1002, ¶235). Rosen provides a simple means to do so: by having a thermostat programmed with the ZIP code of the structure, which is then provided over the Internet to a weather data provider. (Ex. 1010, 7:19-45, 6:50-61, 2:31-38, 7:58-8:41)(Ex. 1002, ¶235). The ZIP code is a commonly-used form of approximate location in the United States, and would have been familiar to a person of ordinary skill, who could have implemented its use in Oswald's system with no unexpected results. The combination was thus obvious. *See KSR*, 550 U.S. at 416-418.

IV. CONCLUSION

Petitioner respectfully requests that claims 1-12 of the '497 patent be

canceled.

Date: May 15, 2020	/Matthew A. Smith/ (RN 49,003) Matthew A. Smith SMITH BALUCH LLP 1100 Alma St., Ste 109 Menlo Park, CA (202) 669-6207 smith@smithbaluch.com *Counsel for Petitioner Google LLC*

CERTIFICATE OF SERVICE

The undersigned hereby certifies that the foregoing petition for *inter partes* review, together with all exhibits and other documents filed therewith, was served by Express Mail on May 15, 2020, on the Patent Owner's counsel of record at the United States Patent & Trademark Office having the following address:

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CERTIFICATE OF WORD COUNT

The undersigned hereby certifies that the foregoing petition for *inter partes* review contains 13,779 words according to the word processing program used to prepare it.

Date: May 15, 2020 /Matthew A. Smith/ (RN 49,003)